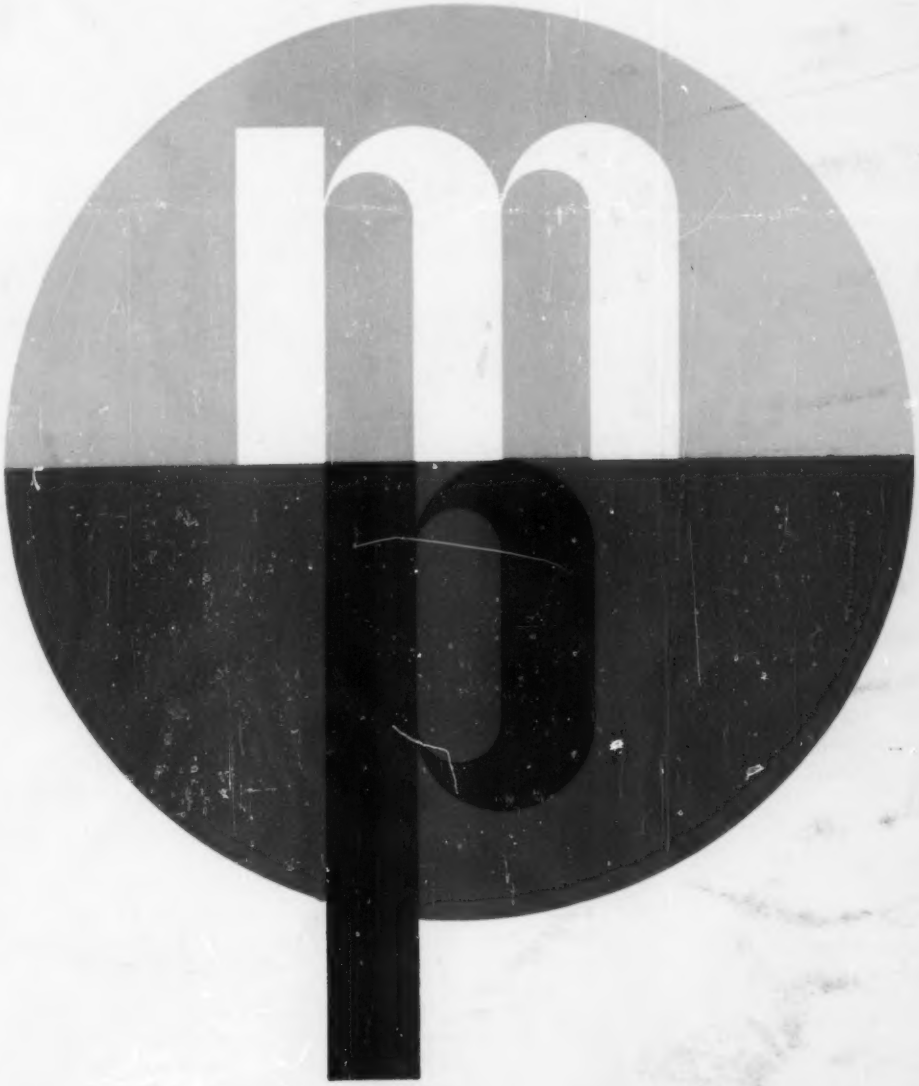
MODERN PLASTICS



September 1957

page 115 Plastics foams in your future

page 122 New field for molded decoration

page 149 How to mold rigid polyethylene

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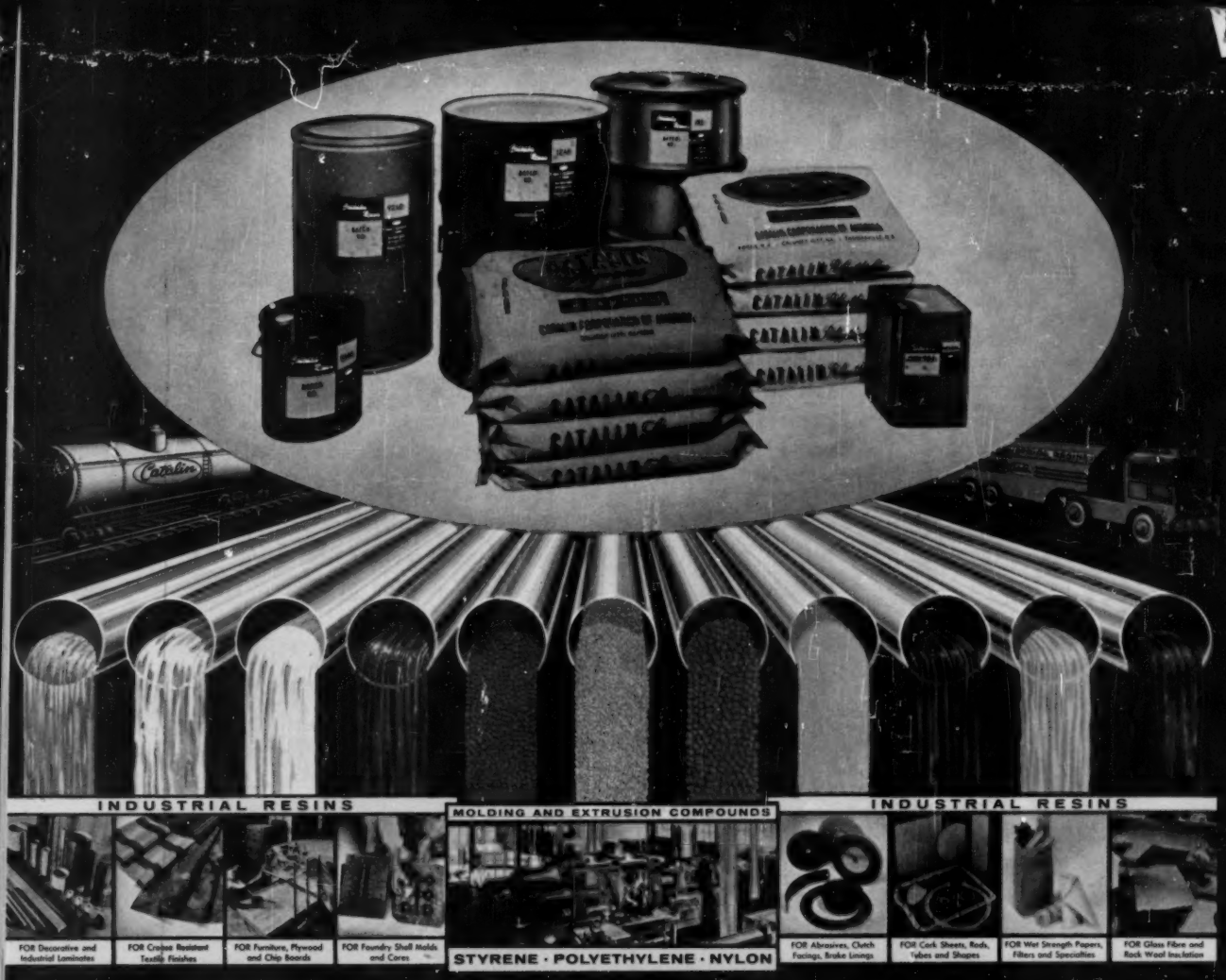
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MODERN PLASTICS

Volume 35
September
1957
Number 1

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Chicago Molded helps develop nylon body for new

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- that's 66% lighter
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This new spray gun will help the do-it-yourselfer to do a more professional job. The entire unit—made by the Electric Sprayit Division of Thomas Industries Inc.—offers home hobbyists new ease of cleaning, ease of handling and greater durability. Models of this new spray gun will be offered by Sears-Roebuck under the Craftsman label, and by independent stores under the Sprayit name.

The behind-the-scenes story is the new application of nylon (Du Pont's Zytel) developed after nearly two years of cooperative research by engineers of Chicago Molded, Electric Sprayit and Sears. By injection molding the entire gun mechanism in a single cavity, several machining, polishing, buffing and plating operations normally required for metal guns have been eliminated. At the same time, the finished product is two-thirds lighter—an important fatigue factor in spraying. And the nylon-to-metal screw threadings make tight seals, guard against leakage of compressed air. Furthermore, nylon is not affected by common solvents, greases, alkalis or oils, and dried paint does not tend to stick to its smooth, lustrous surface.

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Editorial

Your new encyclopedia issue

Within a few days after receipt of this issue of MODERN PLASTICS, our readers will get their copies of the 1957 MODERN PLASTICS Encyclopedia Issue.

We have some things to say about this book.

First, while it has a highly styled and colorful cover, it is not intended to be an item of office decor. It is designed to be used as a tool in production, design, purchasing, engineering, and planning—to be used every day by several or many people.

Second, it is the latest total reference text on plastics materials and processes. Therefore, it is suggested study reading for all junior staff. As a matter of fact, your last year's copy will be avidly read by some college student if you'll fill out and mail us the postcard which you will find inside the front cover of the new book.

Third, in authorship it represents the best explanatory and expositive efforts of specialists in every branch of plastics. It is truly authoritative, since it is the combined work of many authorities.

Fourth, it is easy to use if the key index is the point of entry. Cross-references are as complete as possible. Every attempt has been made, by extensive reorganization of the text, to make it easier for the reader who wants to read quickly and to act fast.

Fifth, a large proportion of the advertisements in the MODERN PLASTICS Encyclopedia Issue have been designed to help the user rather than simply to exhort him. They contain information and bases of comparison not elsewhere available in one location. To the user, they should be quite as valuable as the editorial content.

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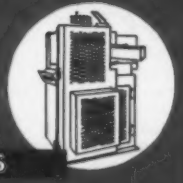

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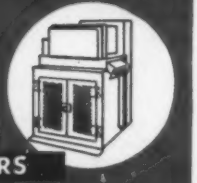

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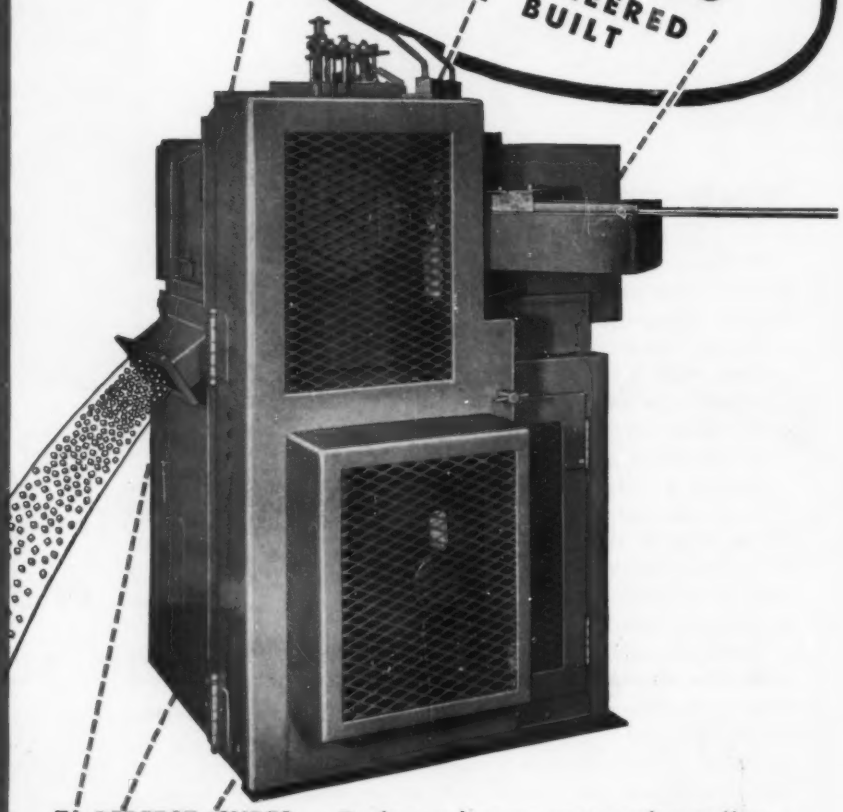

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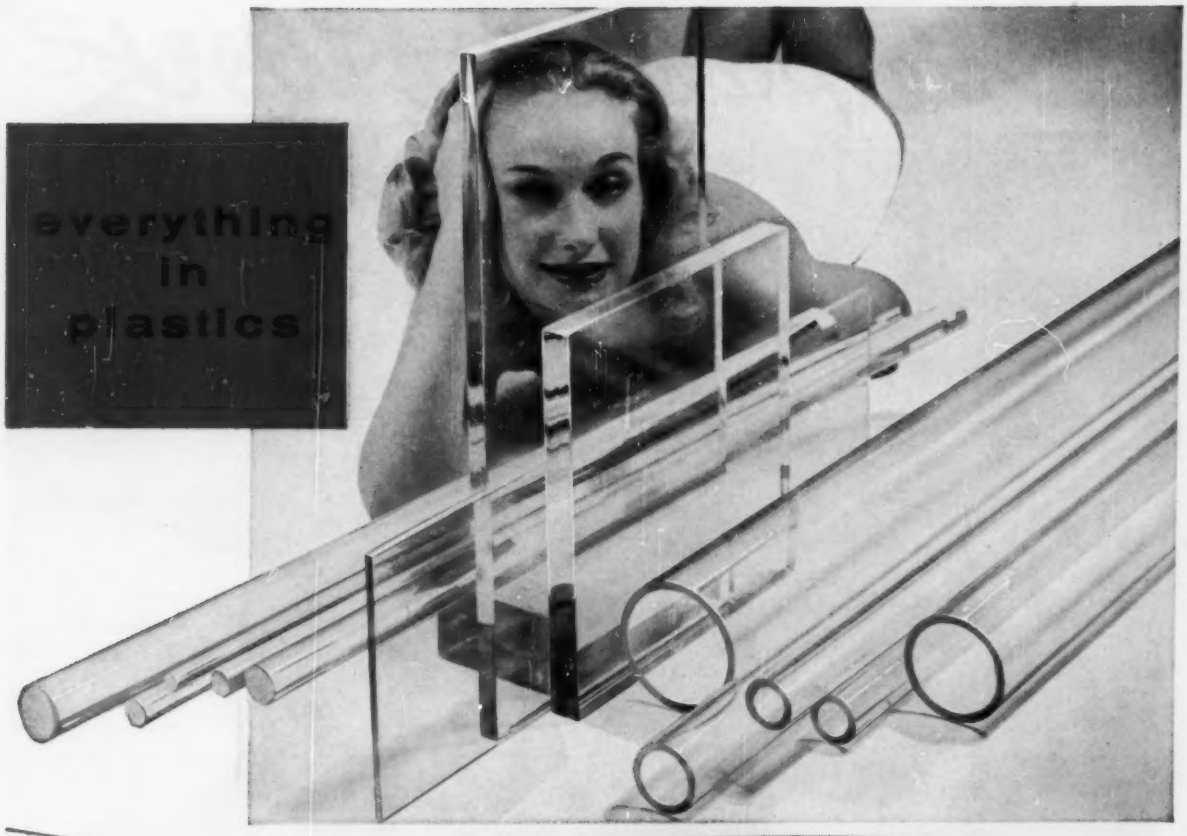

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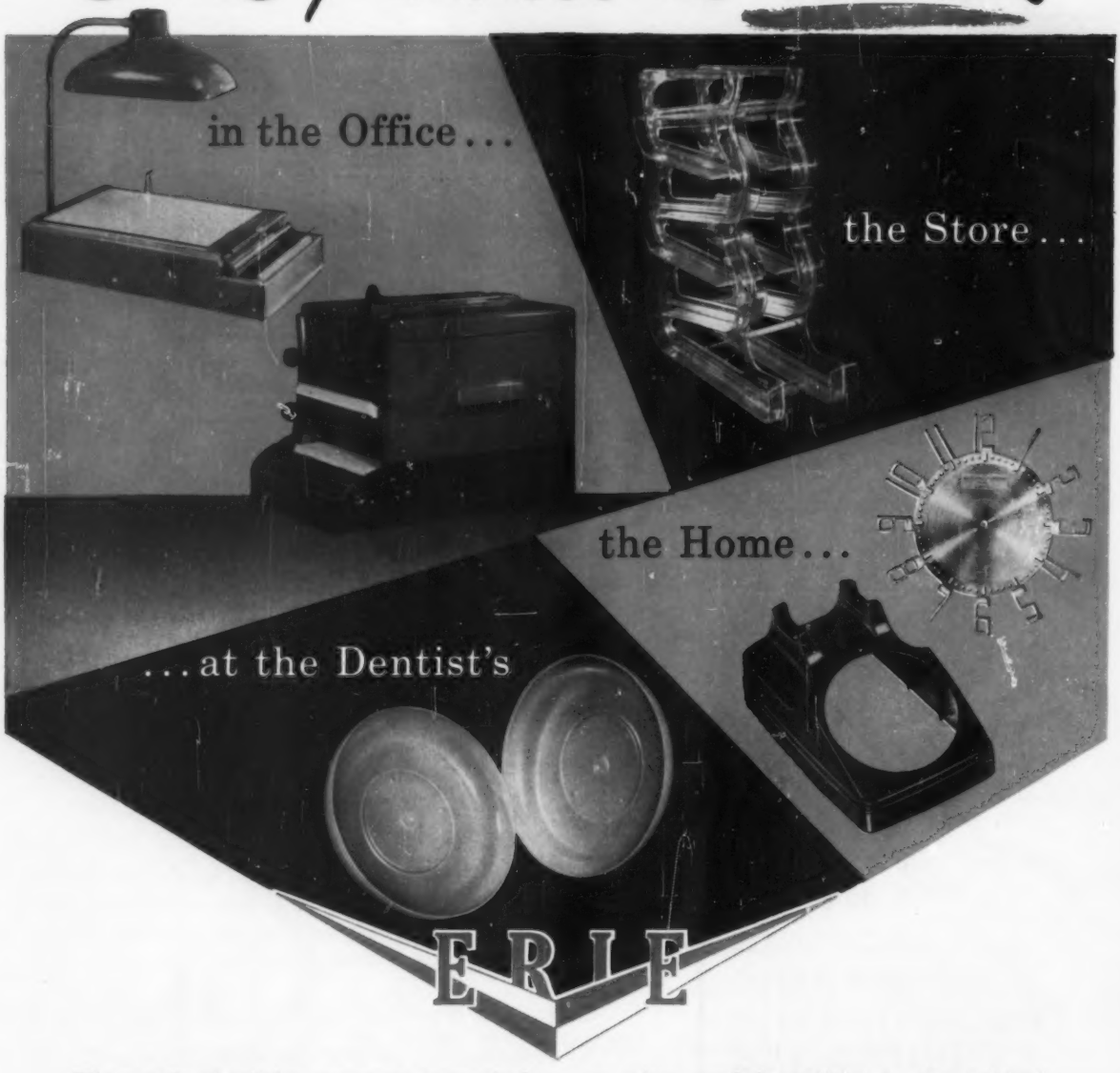

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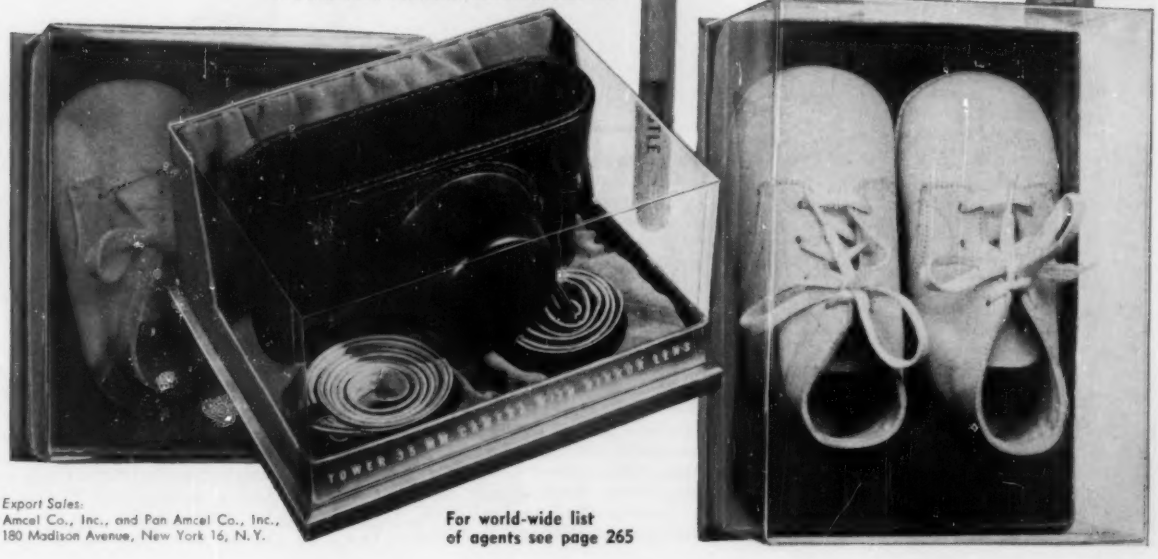

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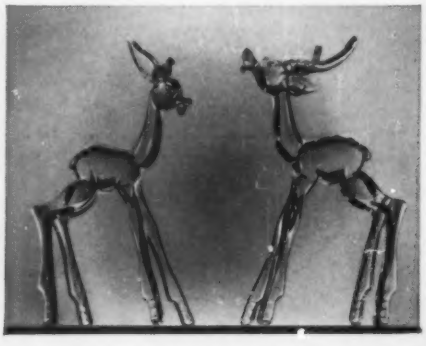

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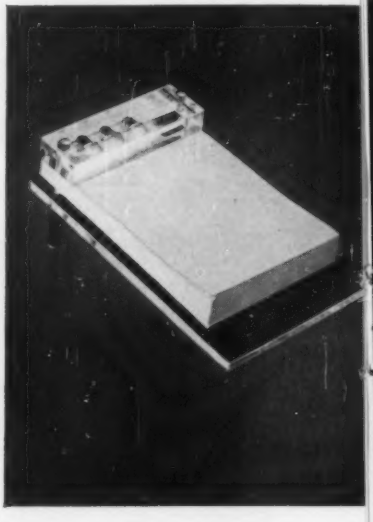

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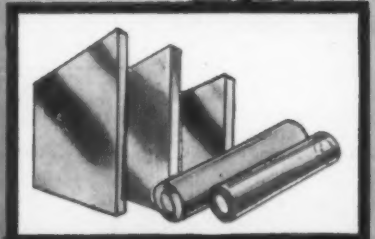

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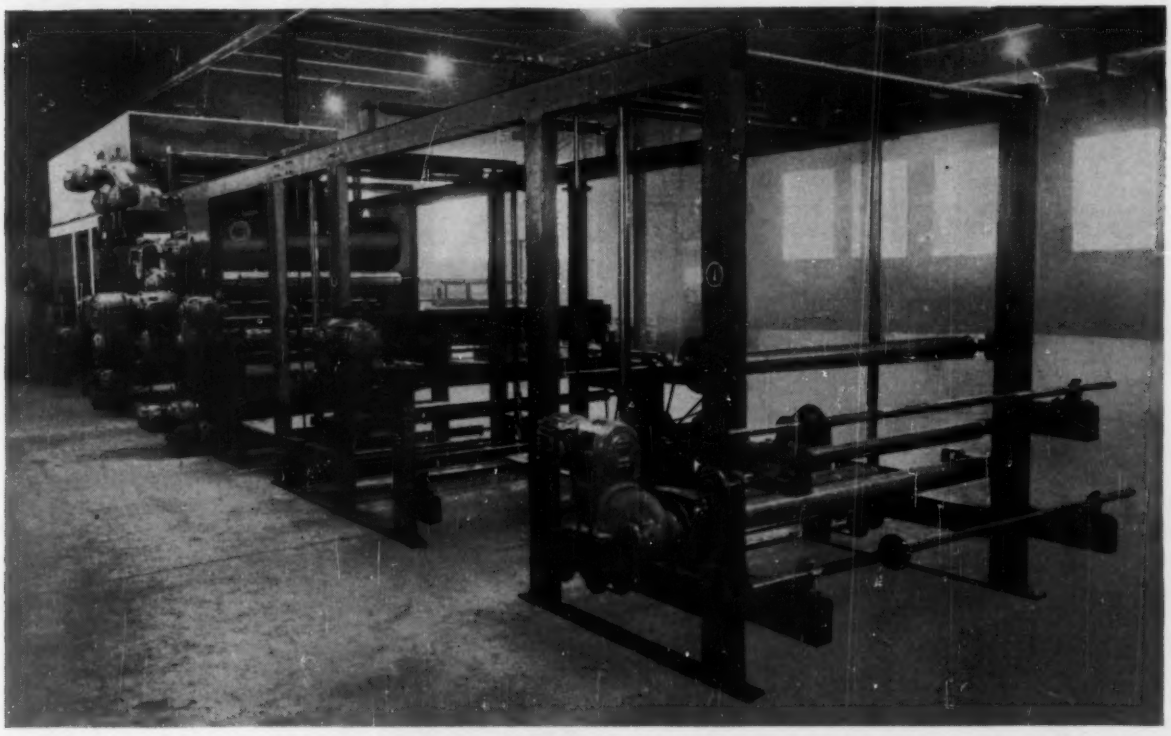

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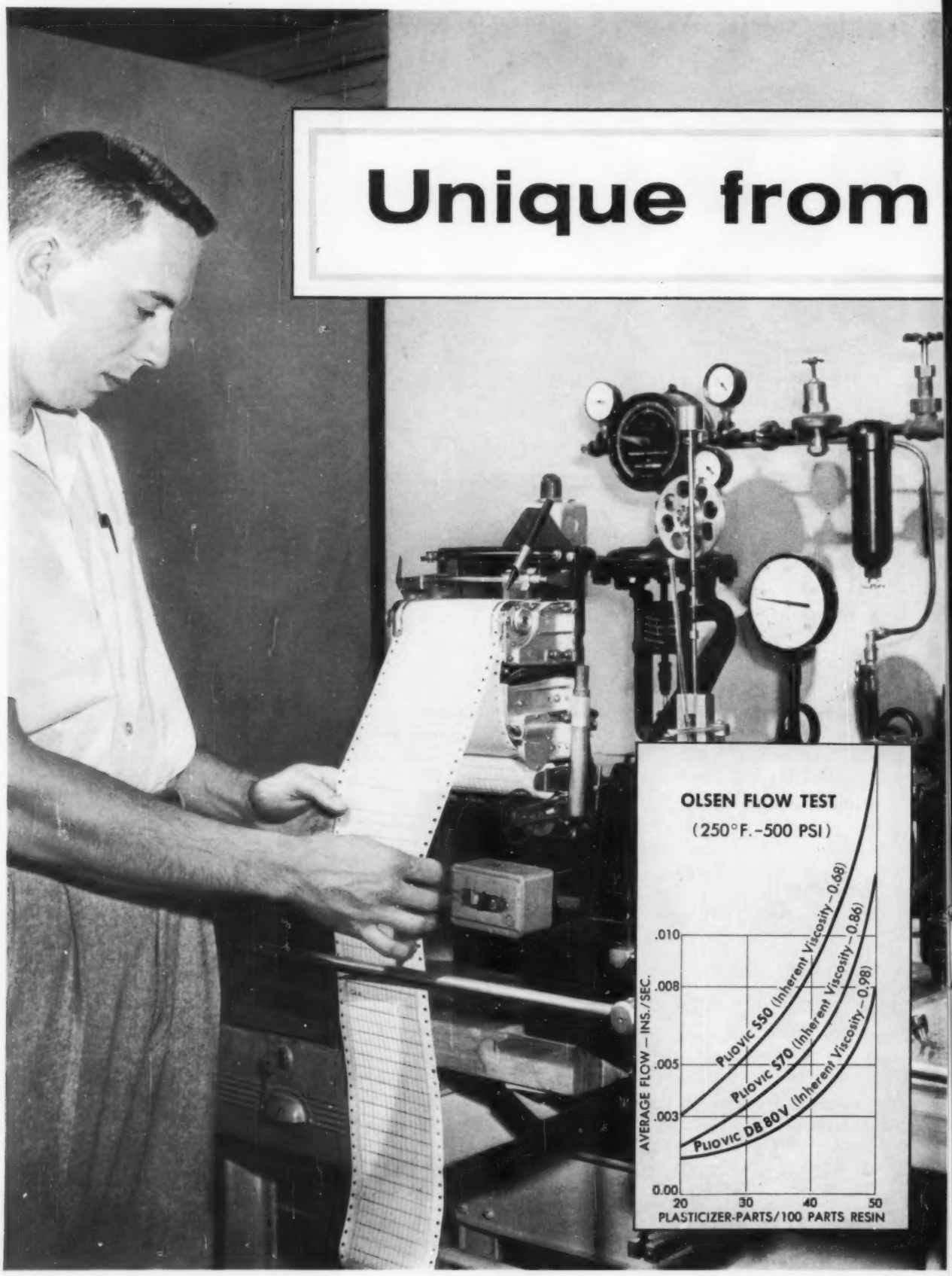


the word – FLOW

That's the new PLIOVIC S50: Completely unique in its superior plastic flow properties. (See data on opposite page.) PLIOVIC S50 is a new kind of unmodified polyvinyl chloride resin of very low viscosity characteristics – in fact, the first modern homopolymer of this type to be offered commercially.

As a result of this lower viscosity, compounds based on PLIOVIC S50 offer these definite processing advantages:

1. Excellent processability at temperatures up to 50°F. *lower* than conventional PVC resins.
2. Easy processing without plasticizers.
3. More faithful reproductions in intricate dies and molds.

At the same time PLIOVIC S50 maintains other properties consistent with those of unmodified vinyls.

There are a number of possible uses for PLIOVIC S50. Most interesting of these is its replacement of copolymer resins in molded, extruded or calendered goods where superior flow plus excellent physical properties are needed. It also can be used in blends to improve the processability of higher molecular weight resins.

If you want to benefit from the word "flow," why not write, today, for full details, including the latest *Tech Book Bulletins*, on PLIOVIC S50. Ask also about the other–both new and established –members of the PLIOVIC family. They're all designed to give you definite product or processing advantages. Address: Goodyear, Chemical Division, Akron 16, Ohio.

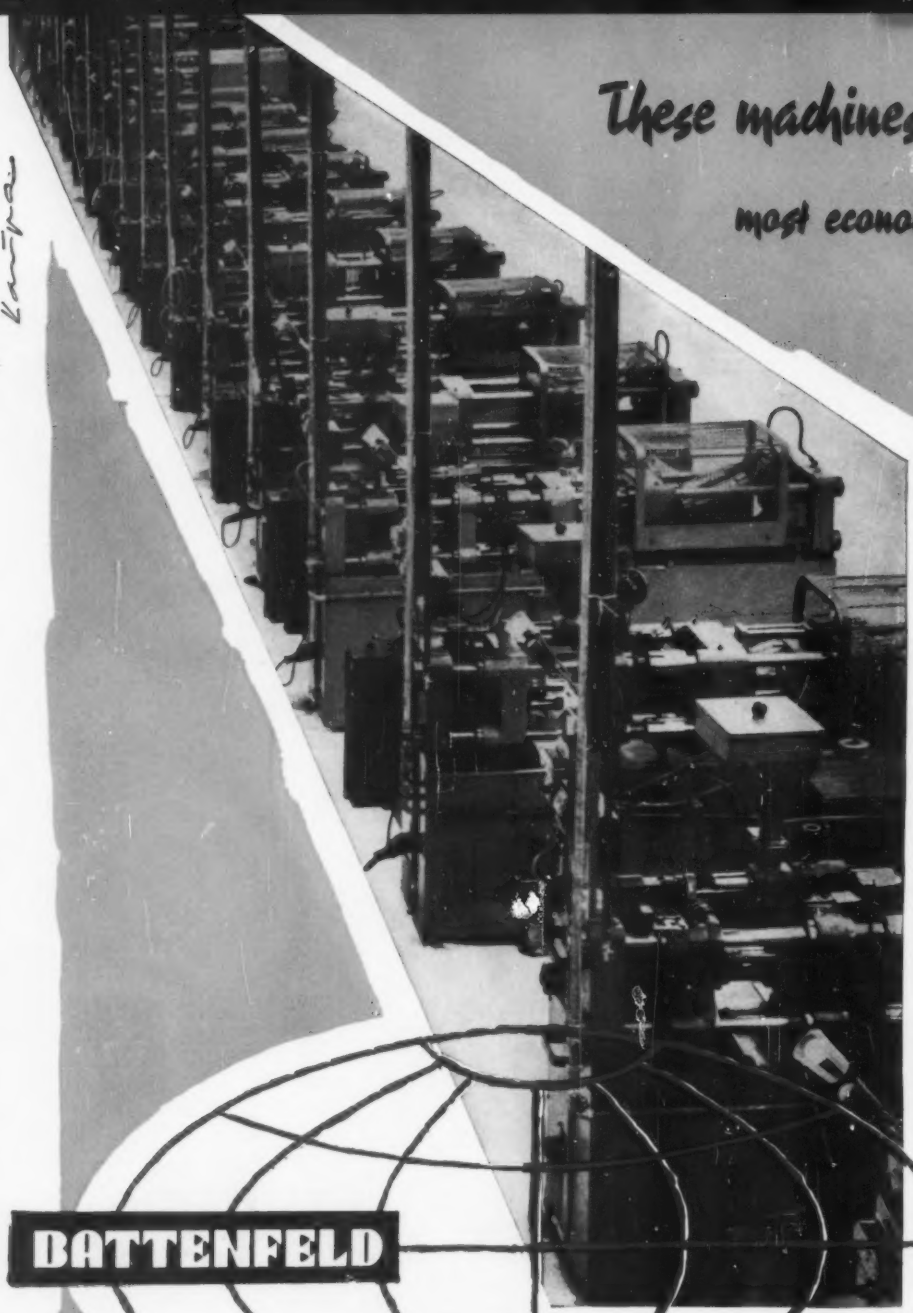
PLASTICS DEPARTMENT

CHEMICAL GOODYEAR DIVISION

CHEMIGUM • PLIOFLEX • PLIOLITE • PLIO-TUF • PLIOVIC • WING-CHEMICALS

High Polymer Resins, Rubbers, Latices and Related Chemicals for the Process Industries

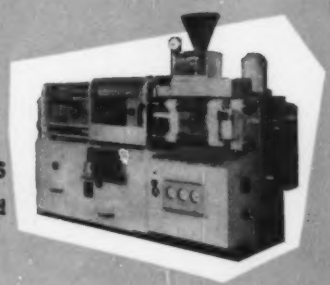
Chemigum, Pliolite, Pliolite, Plio-Tuf, Pliovic—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio



These machines give most economical production

The fully automatic operation, simple electro-mechanical design with an amazing record of quality maintained over long production runs at lowest initial and lowest operating costs are the outstanding characteristics of BATTENFELD INJECTION MOLDING MACHINES

BATTENFELD



More than 2000 Battenfeld INJECTION MOLDING MACHINES are operating in 48 countries all over the world

Sole agents for sales and service MOLDING SYSTEMS INC. DANIELSON, CONNECTICUT

now

Kurz-Kasch announces an important development; the ability to *mold* epoxy parts—in intricate shapes, with inserts—in large production quantities, with molding cycles and economy comparable to conventional thermosetting materials.

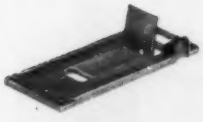
epoxy

The material is molded by techniques developed by Kurz-Kasch from resinous materials supplied by Booty Resineers Inc., Newark, Ohio.

molded

It is no longer necessary to limit yourself to casting procedures to get the benefits of epoxy. Molding cycles are relatively fast; production costs are therefore low. Tooling costs are comparable to other high-pressure plastics.

parts



These parts have exceptional toughness, ability to hold inserts, resistance to moisture and most chemicals, and excellent insulating properties. Call your nearby Kurz-Kasch representative for quotes on parts molded of this material to your specs. Kurz-Kasch, Inc., 1415 South Broadway, Dayton 1, Ohio.

kurz-kasch

New York, Mt. Vernon, Mo 4-4866; Rochester, Hillside 0626; Beverly, Mass., Walker 2-0065; Chicago, Gladstone 6-8837; Detroit, Jordan 6-0743; Atlanta, Cedar 7-5516; Philadelphia, Hilltop 6-6472; Minneapolis, Walnut 6-2749; Dallas, Lakeside 6-5233; Pasadena, Ryan 1-6774; St. Louis, Parkview 5-9577; Toronto, Oliver 7986

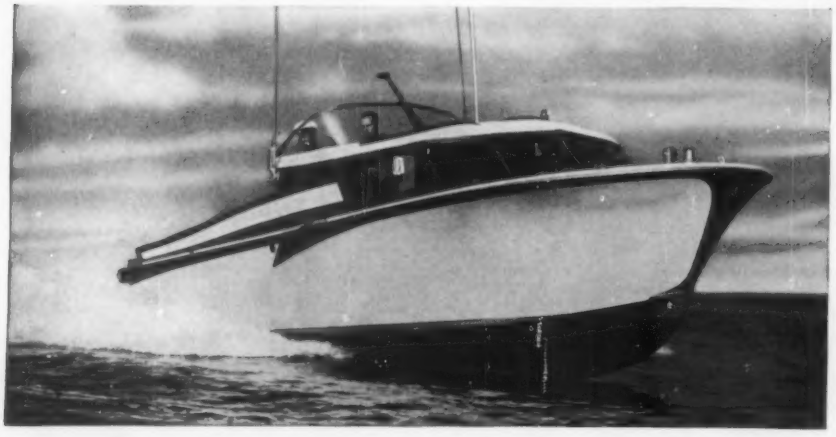
Garan® woven roving wets out and builds up *faster*... cuts production time and cost of reinforced plastics

Garan woven roving can increase your production while reducing labor costs, because it wets out 3 to 5 times faster and conforms to the mold better without extra cutting and fitting. Garan woven roving is less expensive to use than cloth reinforcement because its greater bulk makes build-up 2 to 3 times faster. And finished moldings are color-true because Garan woven roving adds no color of its own to pigmented resins.

Garan woven roving is a coarse, fabric-like reinforcement made from bundles of parallel glass fibers. The exclusive Garan sizing: (1.) protects the fibers during weaving; (2.) improves glass-to-resin bond. Because Garan sizing does these two jobs particularly well, Garan woven roving has special strength . . . makes possible stronger, more durable laminates.

That's why Garan woven roving is the preferred reinforcement among progressive manufacturers of reinforced-plastic products like boats, chemical piping, tooling fixtures, swimming pools and radomes. Find out today how *you* can profit from the timesaving, moneysaving properties you get only by *specifying* Garan woven roving. For sources of supply, write: *L·O·F Glass Fibers Company, Dept. 15-97, 1810 Madison Avenue, Toledo 1, Ohio.*

Garan woven roving wets out faster, improves interlaminate bonding in this speedy 40′ R-class racer by Ray Greene & Co., Toledo.



Garan woven roving gives great strength and durability to this 27′ cruiser designed by John Norek; built by Crystaliner Corp., Newport Beach, California.

L·O·F GLASS FIBERS COMPANY • TOLEDO 1, OHIO

L·O·F GLASS FIBERS

UNICOLOR*

THE SUPERIOR COLOR CONCENTRATE FOR EXTRUSION MOLDING

From pellet to product, UNICOLOR is the color concentrate that adds a whole new dimension to the marketing of plastic goods . . . COLOR-IMPACT.

UNICOLOR actually forms a molecular bond with the thermoplastic involved. It should be fused by diluting at a ratio of **twenty-four to one.**

The result is a color-rich thermoplastic material ready to do the job of capturing the eye of the consumer with its compelling sales appeal.

See how UNICOLOR can do a job for you. Westchester Plastics, Inc. can serve you with thousands of specially matched colors in polyethylene and most other thermoplastic materials, in uniform pellet form, ready for extrusion molding. Advise us of the resin you intend to use and the color you require. We will forward a sample for evaluation by your staff.

remember! the color makes the SALE!

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Custom Compounders of Polyethylene Molding Powder and other Thermoplastic Materials

Manufacturers and Developers of Unicolor and Formacolor

*Pliothene, Formacolor, Unicolor® T.M. Reg. U.S. Pat. Off.

Cut Your MIXING Costs!

IMS DRUM TUMBLER

NOW—3 NEW MODELS

FOR QUICKEST, MOST EFFECTIVE DRY COLOR MIXING

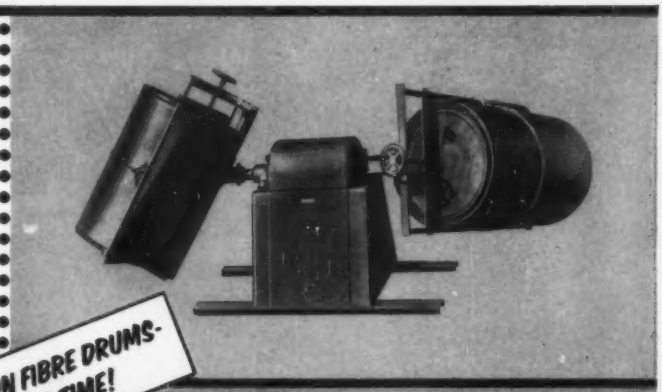
Features: 34 RPM — Positive Drive
Adjustable Drum Holders

T-2

POPULAR MODEL 3/4 HP

Takes drums up to 33" high, and in all diameters up to 22"
Capacity 150 lbs.

Price, complete with motor $595.00



USE YOUR OWN FIBRE DRUMS-SAVE CLEANING TIME!

T-2B

HEAVY DUTY 2 HP

Takes drums up to 37" high, and in all diameters up to 23¼"
Capacity 300 lbs.

Price, complete with motor $863.50

T-2C

EXTRA HEAVY DUTY 3 HP

Takes drums up to 45" high, and in all diameters up to 24"
Capacity 400 lbs.

Price, complete with motor $1285.00

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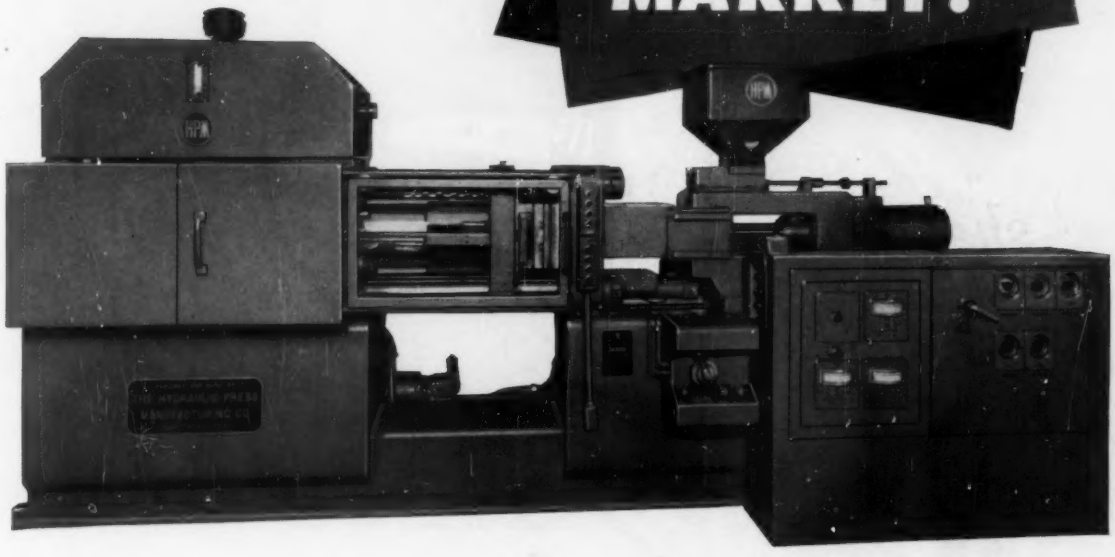
FASTEST 6 OZ. ON THE MARKET!



5 second cycle at full stroke—up to 900 dry cycles per hour

The all-new H-P-M 6/8 oz. plastics injection molding machine is a husky 30 HP unit that offers exceptionally high speed and dependability. Look at this: platen size 26″x26″ . . . 15″ stroke . . . 25″ daylight . . . clamp and injection ends with independent circuits for simplified trouble shooting and faster operation. At full 15″ clamp stroke, 720 cycles per hour are possible—as many as 900 cycles per hour with reduced stroke. This new H-P-M is ideal for all types of difficult custom moldings and will allow you to compete for those high speed jobs such as required in the packaging industry. And, **it's priced right for profitable molding!** Write for Bulletin 5706 or call in a nearby H-P-M engineer, today.

SPECIFICATIONS

Daylight	25″
Stroke	15″
Clamp Tonnage	200
Platen Size	26″x26″
Mold Space (max.)	15″x26″
Plasticizing Capacity	80 lbs. general purpose polystyrene
Injection Speed	675 cu. in./min.
Electric Motor	30 HP

HPM

THE HYDRAULIC PRESS MFG. CO.

Mount Gilead, Ohio, U.S.A.

A DIVISION OF KOEHRING COMPANY

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new ...from Robbins

sheet polishing unit helps you **3** *ways.....*

1 Uniform product

Eliminates porosity and surface imperfections. Consistent surface finish with no wrinkles.

2 Retains finish after vacuum forming

Heat application required in vacuum forming does not impair surface finish.

3 Cuts costs

No laminate material required. Eliminates material and handling costs. Reduces scrap.

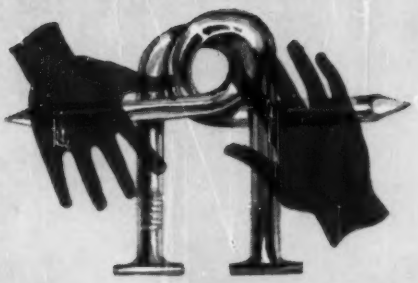
Robbins Sheet Polishing Unit is self-contained with all component parts included in the price of the machine. Write for further information.

Robbins
never say die . . . say Robbins die

PLASTIC MACHINERY CORP.

1430 Mishawaka Street · Elkhart, Indiana

TURN



TWIST

SLIP

SOLVE

a puzzle's a problem only if you haven't worked it before. At Plenco we've successfully solved many production puzzles . . . through the correct application of quality molding phenolics. Chances are we already have the answer to your particular problem. Why not take us up on that?

PLENCO PHENOLICS

FOR BETTER PLASTIC PRODUCTS

PLASTICS ENGINEERING COMPANY

Sheboygan, Wisconsin

Serving the plastics industry in the manufacture of high grade phenolic molding compounds, industrial resins and coating resins.

hi-fax®

HERCULES ETHYLENE POLYMER

A NEW ERA

Unique new "Grease Kup" and large salad bowl were among first products molded with Hi-fax to reach American consumer market. In these uses, resistance of Hi-fax to household greases and solvents is important.

Light weight, durability, and rigidity were other factors prompting its selection. Products each come in three attractive pastel colors, are advertised by manufacturer as "boilproof." *Molded and manufactured by Plastray Corporation, Detroit, Michigan.*

hi-fax® . . . AVAILABLE FOR SUPERIOR

Colorful and durable plastic housewares that won't break or shatter and can withstand exposures in modern automatic dishwashers are now a reality, thanks to Hi-fax. Its advent ushers in a new era in housewares, greatly enlarging the range of usefulness of plastics in a field where consumers familiar with the plus qualities of plastics will readily accept improvements or additions to product lines.

Hi-fax has already been broadly evaluated in housewares, and manufacturers are now geared to convert many existing items to this versatile material for immediate distribution. They are also taking advantage of the properties afforded by Hi-fax to design new merchandise to round out their product listings. Hi-fax promises to find ready use by housewares producers, both as a replacement for plastics previously employed and as an improved material in other spots where before no plastic could qualify.

As compared with conventional polyethylene, Hi-fax is a higher density material, having greater rigidity, heat resistance that permits

IN PLASTICS CHEMISTRY

Hi-fax is a "natural" for large-unit moldings; yields lightweight parts since excessive wall thicknesses are not required to obtain desired degree of rigidity. Richly colorful covered pail and large clothesbasket are both molded with Hercules' new ethylene polymer. Tough, durable, and with a permanently lustrous finish, they won't shatter, rust, or corrode.

A Progress Report from America's First Ziegler Polyethylene Plant

IN QUANTITY HOUSEWARES

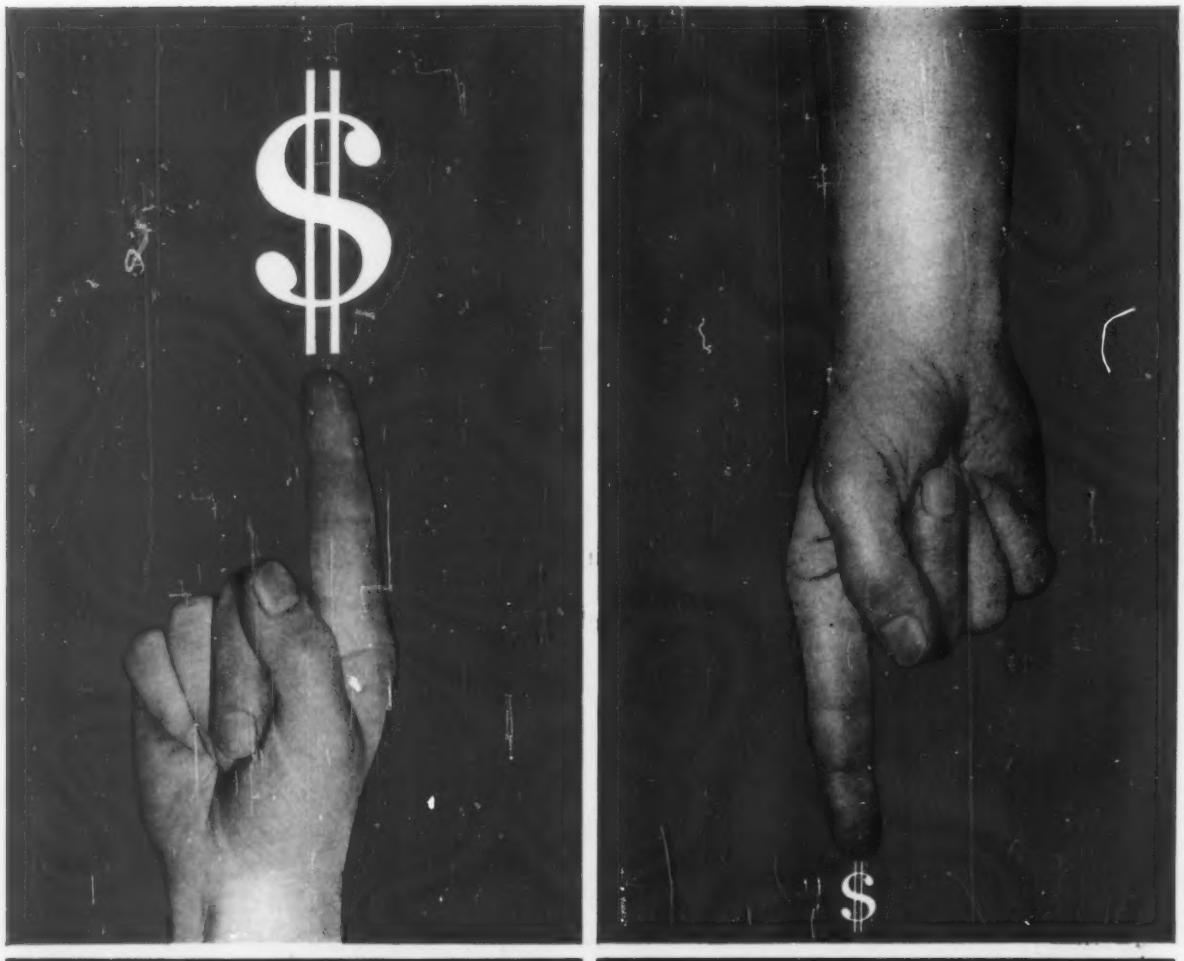
sterilization, and better surface and color range.

Compared with all other large-volume plastics currently in use in housewares, Hi-fax offers greater resistance to breakage, and, as a result, more durable merchandise. Large-unit moldings, such as baskets and pails, made with Hi-fax combine light weight with color, resistance to household chemicals, chipping, breakage, and corrosion, plus a broad range of design possibilities impossible in conventional materials like wood, metal, fiber, or cloth.

Cellulose Products Department

HERCULES POWDER COMPANY
INCORPORATED

900 Market Street, Wilmington 99, Delaware



PROFITS UP! **COSTS DOWN!**

when you use
MUEHLSTEIN *reprocessed plastics*

Big material savings plus top quality and efficient color matches add up to increased profits. And that's what you get when you use Muehlstein reprocessed plastics. You're assured of satisfaction when Muehlstein technicians go to work on your special plastics problem. Call on Muehlstein and watch your profits go up.

Muehlstein offers top prices for distressed inventories of molded parts, purgings, and all thermoplastic materials.

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Looking for more "shots per dollar" in vacuum metallizing coils?

By switching to the best coil design, vacuum metallizers have realized as much as 30% more shots per dollar from Sylvania Tungsten Coils. Why is this possible? Because Sylvania helps vacuum metallizers find the right coil to do their job most economically. Whether you buy ready-made coils or form your own from tungsten strand, Sylvania is ready to help you get maximum efficiency.

If your metallizing process calls for a custom-made coil, Sylvania can recommend the best design consistent with the equipment you're using and the metallizing job to be done. In many cases, metallizers can get top efficiency from an existing Sylvania design, many of which have already become so popular they are considered standard.

Sylvania coils are formed of high-density tungsten strand manufactured to exacting standards of quality control. Sylvania Tungsten Strand is available in 3 to 7 ply with wire diameters of 0.020 to 0.600 inches per strand.

We invite you to write, outlining your specific requirements and problems. You'll find Sylvania is your best source for vacuum metallizing coils designed and built to offer "more shots per dollar."

Sylvania Electric Products Inc.
Tungsten and Chemical Division, Towanda, Pa.

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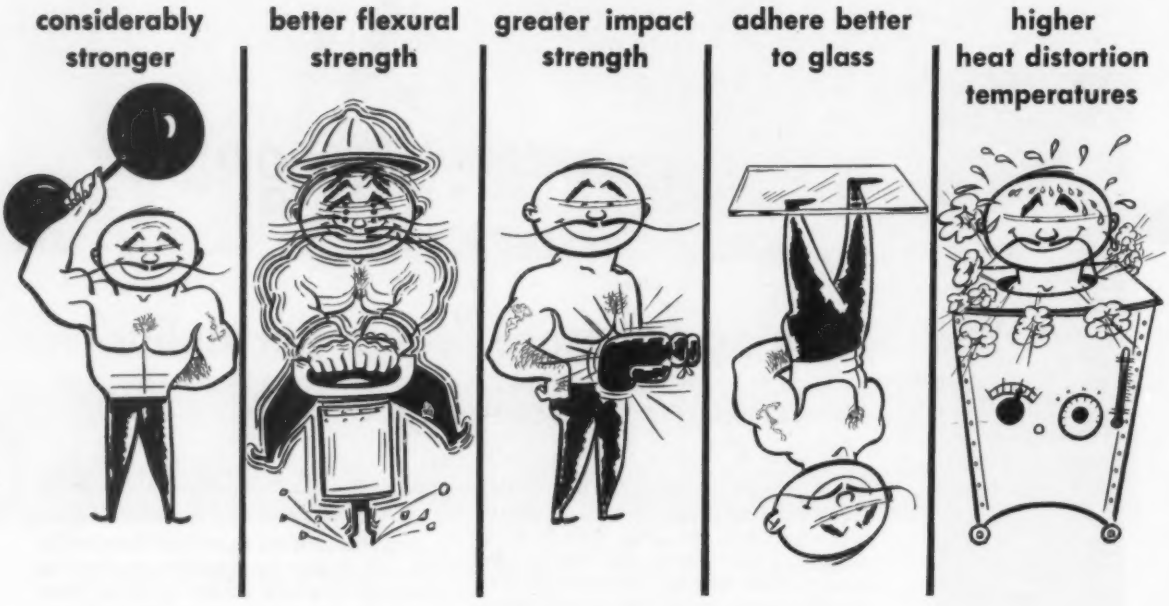
ISOPHTHALIC improves reinforced plastics at low cost!

Greatly improved properties in plastics of unsaturated polyester type are resulting from the use of Oronite* Isophthalic.

Advantages of Isophthalic based plastics



Get the complete story—contact your resin supplier or write Oronite direct for full information. New marketing opportunities are open to you with Oronite Isophthalic.

Ask about the use of Isophthalic in the production of *plasticizers* and *plastics* of polyamide, polyester-amid and polyester types. Isophthalic—the new raw material that's worth your lab time—now.

ORONITE CHEMICAL COMPANY

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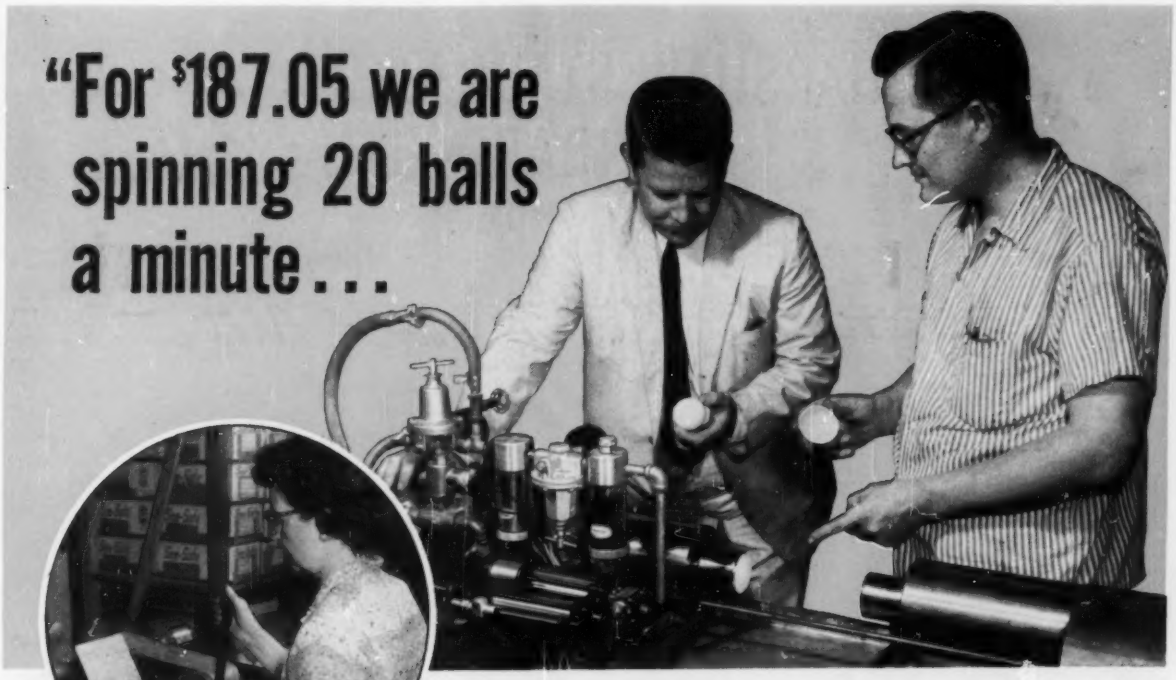
*T.M.

4311

"For $187.05 we are spinning 20 balls a minute...



...we used to get 5"

The Brittain Products Company of Cuyahoga Falls, Ohio, developed a process whereby polyethylene shells are spun in opposite directions, their edges brought together until the friction heat bonds the halves, forming a perfect ball.

Controlling the process by hand . . . as shown in the photo of a woman operator moving the spinning heads together with a hand lever . . . was slow, inconsistent. The production rate was 5 balls per minute, spoilage was as much as 50% depending on the operator's sense of timing. Either too much or too little friction time caused an unsatisfactory bond.

Seeking a positive method of controlling the dwell time of the spinning shells, Brittain Products selected a Bellows Air Motor as a means to bring together and retract the spinning heads which are belt driven by separate electric motors. To provide precision control of the forward stroke of the Air Motor, a Bellows Hydro-Check was mounted parallel to the Air Motor. A Bellows Hydro-Check is a self-contained hydraulic unit which provides accuracy and smoothness to the fast action of the Air Motor. Several limit switches and an air filter completed the $187.05 Bellows equipment cost.

In operation, Brittain Products' patented "Ball Sealing Machine," as it is called, requires the operator's attention only to place the shells in the constantly spinning heads (start and stop switches for the electric motors are separate controls) and depress a button-switch with each hand to actuate the Air Motor.

This unique application of Bellows "Controlled-Air-Power" is typical of the way ingenious methods engineers apply Bellows air-powered devices to a wide range of operations. Whether the operation calls for the conversion of existing hand operated equipment to fast automatic or semi-automatic units, or the development of equipment designed for a specific job, Bellows work units will save design time and machine building costs.

Phone your Bellows Field Engineer (he's in the book under "The Bellows Co.") — ask him to show you the many ways in which Bellows "Controlled-Air-Power" Devices can help you cut production costs.

891-B

Or write direct for Bulletins ML-3 and BM-25. Address Dept. MP-957, The Bellows Co., Akron 9, Ohio. In Canada—Bellows Pneumatic Devices, Ltd., Toronto, Ontario.

The Bellows Co.
AKRON 9, OHIO

In these five Standard Units are all the necessary components to control effectively the degradation mechanisms that take place in polyvinyl chloride resins on aging, during heat processing or on exposure to sunlight. They are widely used alone and in combinations for specific effects in clear and opaque stocks. Their advantages have been proven over other tested materials, such as those based on tin (which frequently decolorizes effects of degradation without correcting them) or on lead (which frequently contributes to oxidation and breakdown on aging). We also supply combinations of components selected from these five Standard Units, to correct special conditions encountered in each Vinyl Processing Industry.

Write for information about stabilizers designed for versatile and inexpensive use in formulations employed in your particular vinyl processing industry.

Is it for—

Quality Vinyl Flooring?
Non-Plating Calendered Stocks?
Maximum Clear Sheets?
Non-Sulfur Staining Films?
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Air-Releasing Plastisols?
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This Stabilizer System is for

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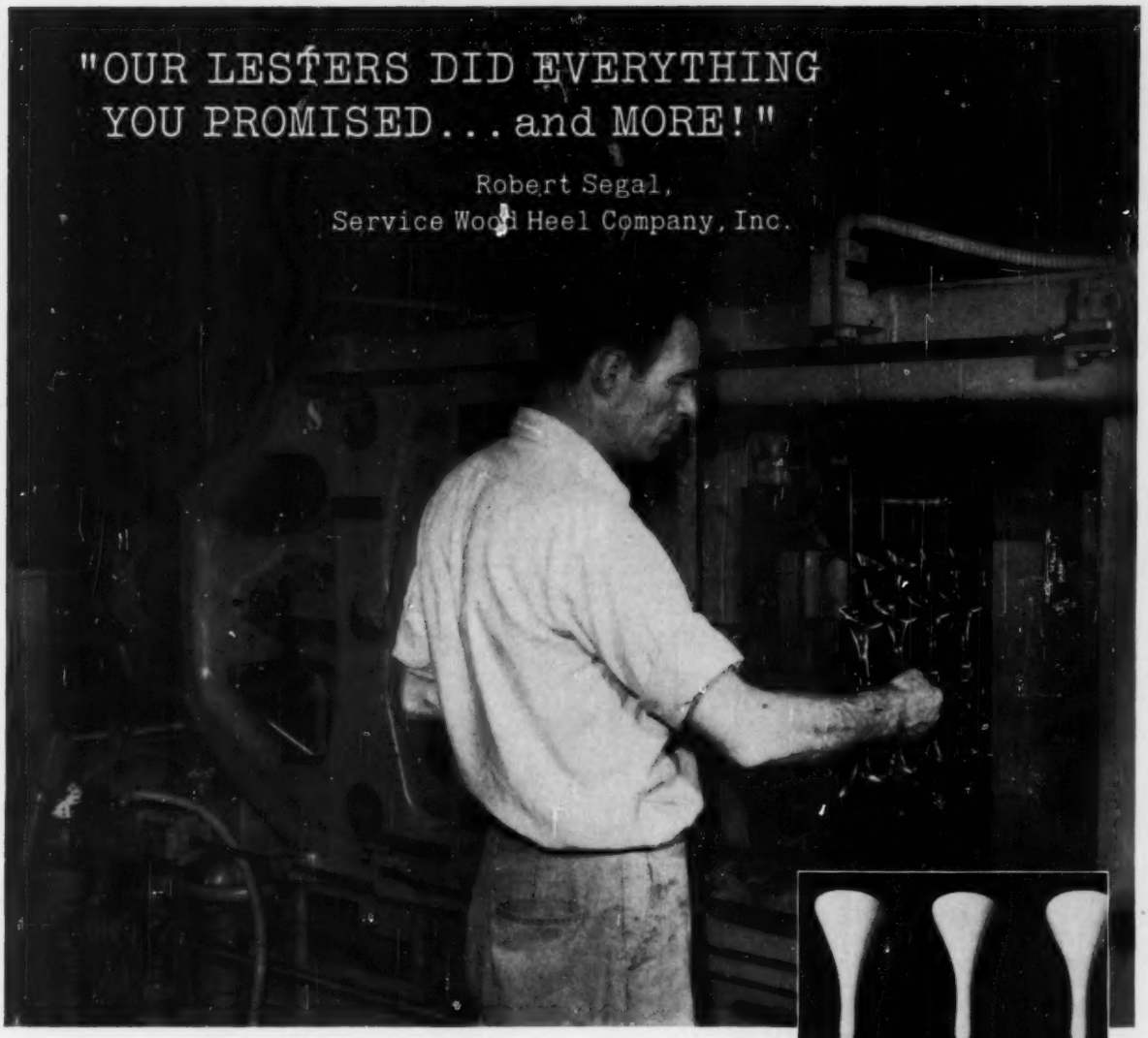
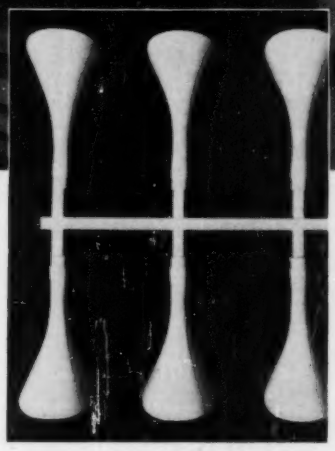
"OUR LESTERS DID EVERYTHING YOU PROMISED... and MORE!"

Robert Segal,
Service Wood Heel Company, Inc.





"When we first discussed our plastic heel molding project, you told us that your machine would surprise us by its performance. I want to let you know that we are getting 16% more production on your machine than on any other. It's better than anything we've ever seen before. Our Lesters did everything you promised...and more!

Sincerely,

Robert A. Segal

Robert Segal,
Service Wood Heel Company, Inc.

P.S. Can you improve delivery on the other two machines we've ordered?

Want complete specifications? Write today for Bulletin 202.

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Another **FIRST** from Gilman...leader in plastic sheet for the Vacuum Forming Industry...**FIRST** to introduce a decorated sheet...**FIRST** to produce a scratch resistant styrene sheet that retains the original grain after forming.

NOW... in cooperation with the Nashua Corporation, Gilman is the **FIRST** to offer a plastic sheet flocked before forming. STYLOUR* is a velour-coated, special formulation, super-high impact styrene sheet which retains its velvety finish after forming. The basic Gilman sheet is coated with cotton or rayon flock in a variety of brilliant colors. It is available in a wide range of thicknesses, lengths, widths and plastic finish combinations.

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Stylour*

PLASTIC SHEET FLOCKED BEFORE FORMING

Write for further information...

THE GILMAN BROTHERS COMPANY

ESTABLISHED 1897 • GILMAN, CONNECTICUT

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Slitters and Roll Winders

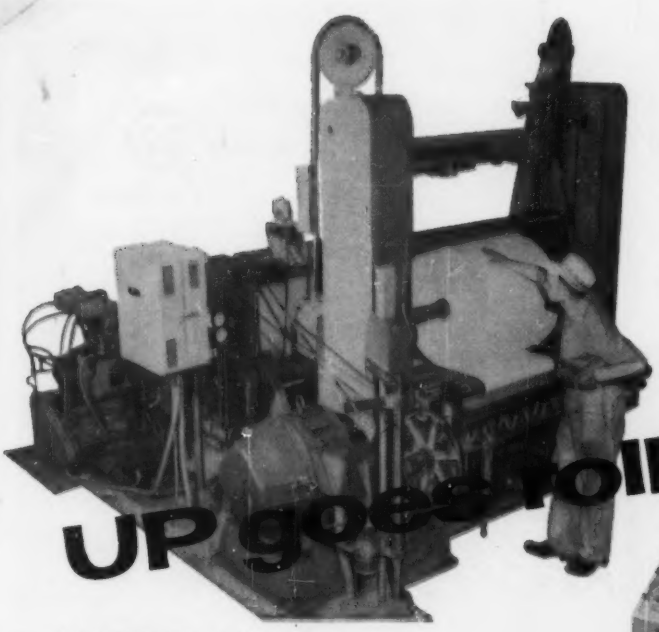
Custom-engineered by Cameron specialists

. . . to meet all production requirements

. . . to produce rewound rolls of highest quality

. . . to assure trouble-free feeding in subsequent roll finishing, printing and converting operations

. . . to increase the sales appeal of roll-wound products made for end use.



UP goes roll quality!

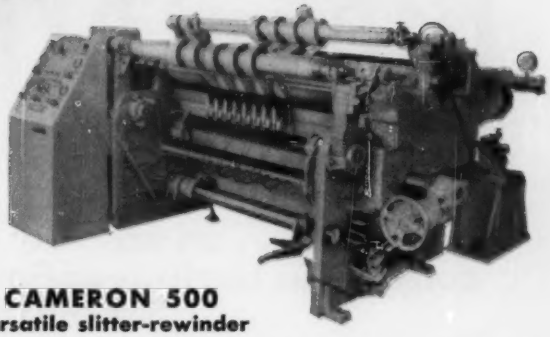
CAMERON 10
heavy duty slitter-rewinder

. . . score-cut or shear-cut slitting.

. . . speeds up to 2000 fpm*; widths 42" and 82"; rewind diameter to 40" maximum.

. . . surface rewind, with self-aligning riding roll to compensate for off-caliper stock.

. . . versatile handling of waxed, gummed, or coated paper or paperboard, textiles and rubber.



CAMERON 500
versatile slitter-rewinder

. . . quick changeover from score-cut to shear-cut or razor-cut slitting.

. . . speeds up to 2000 fpm*, widths to 62"; rewind diameter to 20" maximum.

. . . surface and center rewind, differential type, with air-loaded core friction.

. . . for plastic films, foils, papers, textiles and laminated materials.

DOWN go your costs!

CAMERON 550
low-cost slitter-rewinder

. . . score-cut, shear-cut, burst-cut or draw-cut razor slitting.

. . . speeds up to 500 fpm*; widths to 62"; rewind diameter to 15" maximum.

. . . center rewind, differential type, with air-loaded core friction.

. . . for plastic film, foils, papers, laminates and other materials.

*Speed is dependent upon machine width, the number of cuts, and characteristics of material.

A SOUND INVESTMENT in slitting and roll winding equipment will pay three-fold dividends:

. . . it will attract profitable new business by producing rewound rolls that meet the highest standards of quality.

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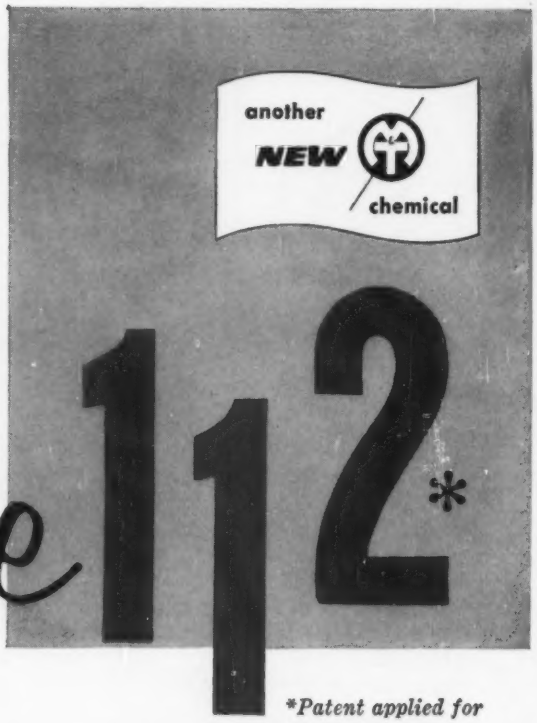
AA-335



Thermolite 112*

**Patent applied for*

. . . an entirely new concept in barium-cadmium stabilization

. . . complete freedom from fatty acids and octoates

Thermolite 112 is used in:

film and sheeting . . . extrusions
. . . plastisols and organosols.

CLEAR VINYLS —to approach optical clarity with outstanding light stability —superior heat stability gives excellent initial color and holds color during processing—offers freedom from "plate out".

PIGMENTED VINYLS—initial color maintained with no color drift during processing.

Metal & Thermit now brings you an entirely new type of stabilizer for polyvinyl chloride film, sheeting, extrusions, and dispersions. Thermolite 112, the first barium-cadmium stabilizer completely free from fatty acids and octoates, offers heat and light stability, clarity, and heat sealing and printability characteristics heretofore unapproached by a barium-cadmium system. Hose manufacturers will be especially pleased at the increased water resistance and lower hazing with Thermolite 112.

For all applications, the unique chemical structure and physical properties of this new stabilizer provide unlimited opportunity for lowering costs and improving quality. "Plate out" on calender rolls is reduced to a minimum. Substantial savings result from the powerful action of Thermolite 112 permitting the use of very small quantities of stabilizer for many formulations. In some cases, Thermolite 166, our zinc stabilizer, can be substituted for part of the barium-cadmium, thus further reducing costs. Both of these new Thermolite stabilizers are liquid and can be added directly to the plasticizer, thereby eliminating costly grinding or pre-blending.

Literature providing details about Thermolite 112 and Thermolite 166 is available upon request.

HEADQUARTERS FOR HEAT AND LIGHT STABILIZERS: The M&T Thermolite line also offers the most complete selection of organotin heat and light stabilizers in the field. Write for details.

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GENERAL OFFICES: RAHWAY, NEW JERSEY

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4. Low initial cost and no maintenance cost. (You can re-use Air-Loc mounts.)

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MIBK is also used in the manufacture of such products as fungicides, textile coatings, leather finishing, pharmaceuticals, germicides and the denaturing of ethyl alcohol.

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SHELL

The Plastiscope

September 1957

News and interpretations of the news

By R. L. Van Boskirk

Section 1

Vinyl chloride in 1957 running ahead of 1956. If vinyl chloride keeps up the same pace in the last half of 1957 that it did in the first half, sales volume will be a little over 600 million lb. compared to 567 million in 1956. Probably an additional 10 or 15 million lb. of imported resin will also be processed in this country. Each of the first six months ran ahead of 1956 and summer sales were not down as much as usual. The total sales volume of domestic resin in the first half was just about 300 million lb. compared to 275 million in 1956. Thus, vinyl has withstood the decline in housing and the leveling off in automotive markets and gone on to expand its invasion of other outlets. In addition, there may be 10 or 20 million lb. or more from new producers who are not reporting.

Sales volume for resin used in film and sheeting in the first half of 1957 was about 73 million lb.; in 1956 it was 65 million. Molding and extrusion grade was about 112 million lb. in 1957; in 1956 it was 97 million.

Capacity for vinyl chloride. There is plenty of capacity for most grades of vinyl to far more than meet the above sales volume. By the end of this year installed capacity will be approaching 850 million pounds. In addition, there is an interesting report going the rounds to the effect that Bakelite will soon expand its capacity to produce VYHH, the type of resin used without plasticizer for such items as phonograph records, can coatings, and certain types of vinyl floor coverings. This is the resin which has been through several "scarcity" periods during the past few years. Just a month ago it became known that Bakelite was introducing its first dry-blend resin for extrusion purposes to put them into competition with competitors who had been in the market for several years, but nothing was said about adding new facilities to produce it. Perhaps these developments will end the mystery of what Bakelite has been doing while watching its old and new competitors expand or build new plants.

Capacity for vinyl monomer. Most of the larger vinyl chloride polymerization plants produce their own monomer. Some have a surplus. Dow, with an estimated 60 or 70 million-lb. plant, probably has more to sell than any other polymerizer, since they use less for their own purpose. Semet-Solvay brought in an estimated 40 million-lb. capacity monomer plant a year or so ago and plans to almost double that capacity soon. Ethyl Corp. is planning a monomer operation in the near future. When these new facilities come in, capacity for monomers will approach 1 billion pounds. Aside from Firestone and Escambia, the customers for surplus monomer are the new plants that have come in during the past year, each of whose capacity for production of polymer ranges

*Reg. U.S. Pat. Off.

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TEFLON	√	√	√	√	√	√	
VINYLITE	√	√	√				
ACETATE	√	√	√	√			
POLYSTYRENE	√	√	√			√	√
POLYETHYLENE	√	√	√	√		√	
PHENOLIC LAMINATES	√	√	√				

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The Plastiscope

(*Continued from page* 37)

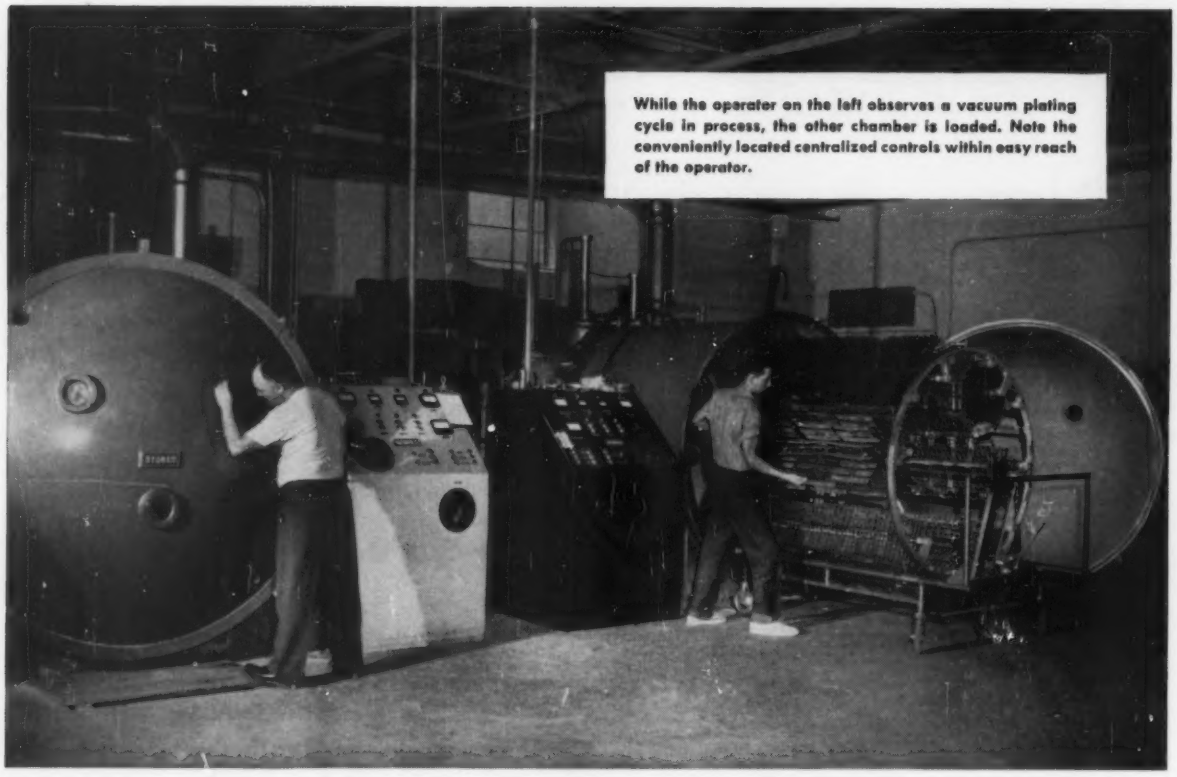
from 6 to 12 million pounds. A mild commotion was created among them earlier in the year when monomer price was raised by 0.7¢/lb. due to escalation. That raise brought monomer up to about 11¾¢ and someone planted a story that vinyl resin was going up as a result. It was a phony story. It's practically a 100 to 1 bet that the price for general-purpose vinyl resin isn't going up in the foreseeable future unless some great emergency or inflationary factor arises. It is also a pretty good bet at this time that the present price of 27¢ is likely to remain just that for some time, but the general feeling is that when a change comes for vinyl polymers it will be downward and *not* upward, even though monomer should continue upward to a moderate degree. At least, one can get more bets on the down side.

Semi-rigid, clear vinyl chloride sheeting. What appears to be another variation of the clear vinyl chloride sheetings now on the market is being produced by Chas. S. Fields Corp., Lodi, N. J. It is a calendered sheeting with clarity almost equivalent to press-polished clear vinyl. It is believed to contain about 10% plasticizer and consequently is called semi-rigid. It combines the properties of rigid and flexible sheeting by having the clarity of the more flexible auto seat-cover stock, plus a measure of stiffness. It is furnished in thicknesses of from 6 mils up and is delivered in rolls. Cost is 60¢/lb. compared to press-polished clear at around $1.00 and the automotive-type flexible material at around 50¢/pound. Prospective markets are wallets, protective coverings for business and identification cards, graphic arts, and particularly for vacuum formed package applications.

Phenolic molding compound in rod form. The Fiberite Corp., Winona, Minn., is now producing phenolic and melamine impact molding materials in rod form. Advantages of the rod form are listed as: reduction of bulk factor (1.7 to 1); no loss of strength; elimination of preforming; less handling; and automatic molding. Magazine feeding devices will be suggested by Fiberite.

Arc-resistant phenolic with high impact. Another new Fiberite product is a phenolic that is claimed to have arc resistance equal to that of melamine and polyester. Called Fiberite 6100, this material, which is an asbestos cord-reinforced compound, is claimed to have a 5.0 Izod impact. Comparable materials do not generally go over 3.0, except those that are glass- or macerated fabric-filled. Despite this high impact property, the material can be easily molded by transfer or plunger methods. Fiberite is pointing this new formulation toward applications where melamine and alkyd fibrous glass-filled materials are now used and such other items as switch bases, electrical connectors, heavy-duty sockets, and insulators.

Medium-price-range molding materials. When Marbon Chemical recently reduced the price of Cycolac, attention was focused on a developing situation in plastics molding materials that is likely to become the most competitive and toughest-to-sell section of the industry. This is in the area where materials



While the operator on the left observes a vacuum plating cycle in process, the other chamber is loaded. Note the conveniently located centralized controls within easy reach of the operator.

Jayron Corp. credits continuous growth to Stokes vacuum plating equipment...

Jayron Corp., Leominster, Mass. is one of the country's largest custom vacuum platers. Hundreds of millions of parts are processed annually. Their own advanced engineering on auxiliary processes and techniques enables Jayron to meet all competition.

Mr. Boris Levine, President and Treasurer of Jayron, when asked about Stokes equipment in his plant, replied—"This is the third vacuum metallizer we have purchased from Stokes . . . each successive machine, with their new innovations, have always proved themselves in operation . . . we average three to four cycles per hour throughout the year, and the very growth of our company is due in part to the excellent equipment we operate."

Vacuum plating . . . often known as vacuum metallizing can impart a distinctive gold, brass, copper or chrome finish, to conductive or non-conductive parts, at extremely low costs. Stokes vacuum metallizers feature interlocked centralized controls, making it easy for men to learn operating routines. Production to consistent quality standards can be met with minimum labor. The equipment is compact and self-contained . . . takes little floor space.

Investigate this low-cost method for finishing metals or plastics. Stokes can give you practical help in overall planning . . . determine plant layout as well as production techniques, rates and costs . . . select lacquer and auxiliary equipment . . . train your operators. Contact the nearest Stokes office, or write for additional data on Stokes Vacuum Metallizing equipment.

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STOKES

The Plastiscope

(*Continued from page* 39)

are priced in the range of from near 40 to 70¢ or slightly over. Nearly all of the materials are attempting to compete for many of the same markets. Sales volume in this sector today (molding only) probably isn't much over 130 million lb. compared to a 400 million-lb. volume for GP and impact styrene. Present and projected capacity for all of these materials is several times present sales volume. A sales manager confronted with this situation is certain to acquire a horrible case of heebie-jeebies if he dares to examine it in a serious mien. The molding materials involved are enumerated, with their per-pound prices, in the following paragraph.

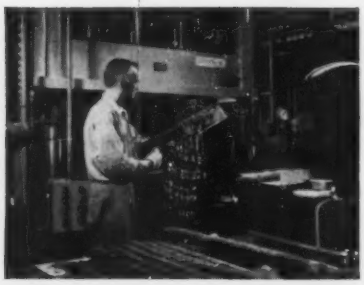
That tough selling area. A list of thermoplastic molding materials in the 40 to 70¢/lb. price category (basic prices given are for large-volume delivery and in natural or crystal unless otherwise specified) follows: Cycolac, mentioned above, is now 58¢ in pellets and natural or standard colors, was formerly 65 cents. In powder form it is 53¢, down from 58 cents. Kralastic, 53¢, but with several variations. Butyrate, 62 cents. Methacrylate standard, 55¢—new impact methacrylate in experimental lots, 56 cents. Styrene-acrylonitrile copolymers, such as C-11, Styrex, or Cymac, 40¢ in 80,000-lb. lots—42 in 20,000. Extra-high-impact styrene, 38½¢ in natural, 42½ in color. Forticel, 62 cents. Hercocel-W, 56 cents. Clear acetate, 50 cents. Translucent acetate, 46 cents. Opaque acetate, 38 cents. Ethyl cellulose, 72 cents. Plio-Tuf, a styrene-butadiene molding compound, 41 cents. Medium-density polyethylene, 41 cents. High-density polyethylene, 47 cents. Rigid vinyl at 42¢ and some plastisols in a wide range of prices are also in this price bracket, but most of their uses in molded articles are in different fields.

There will probably be severe changes in some of the above prices in the next year or so. Not many people think that high-density polyethylene will stay at 47¢ when volume gets big and competition more severe. The past declines in styrene and acrylonitrile monomers may also be reflected in lower copolymer prices as the fight for markets becomes more bitter. The best way to get lower prices is to find more large-volume markets and that's where the molders can do some effective tinkering.

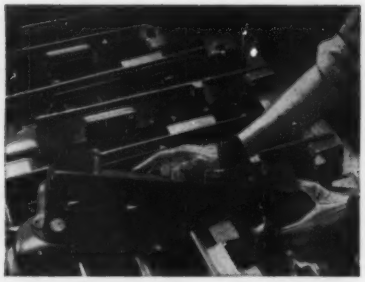
Whaddayoucallit polyethylene. A great puzzle to the plastics industry has been how to label the different polyethylenes in order to distinguish one from the other. This department has been informed that A.S.T.M. is going to recommend the following designations: polyethylene with a density of from 0.910 to 0.925 will be called "lower density"; 0.926 to 0.940 will be "medium density"; 0.941 to 0.965 will be "higher density." It is likely that future developments will also result in a "lowest density" name for material under 0.910 and "highest density" for material over 0.965. Molders seem to be gradually accepting the name "linear polyethylene" for the low-pressure-processed polyethylene, but A.S.T.M. thinks that "density" is a more accurate descriptive title.

American polyethylene abroad. A new Italian company named Celene, S.p.A., has been formed by Union Carbide Corp. and Societa Edison of Milan to build a 24 million-lb. high-pressure polyethylene plant in Italy. The Edison group pro-

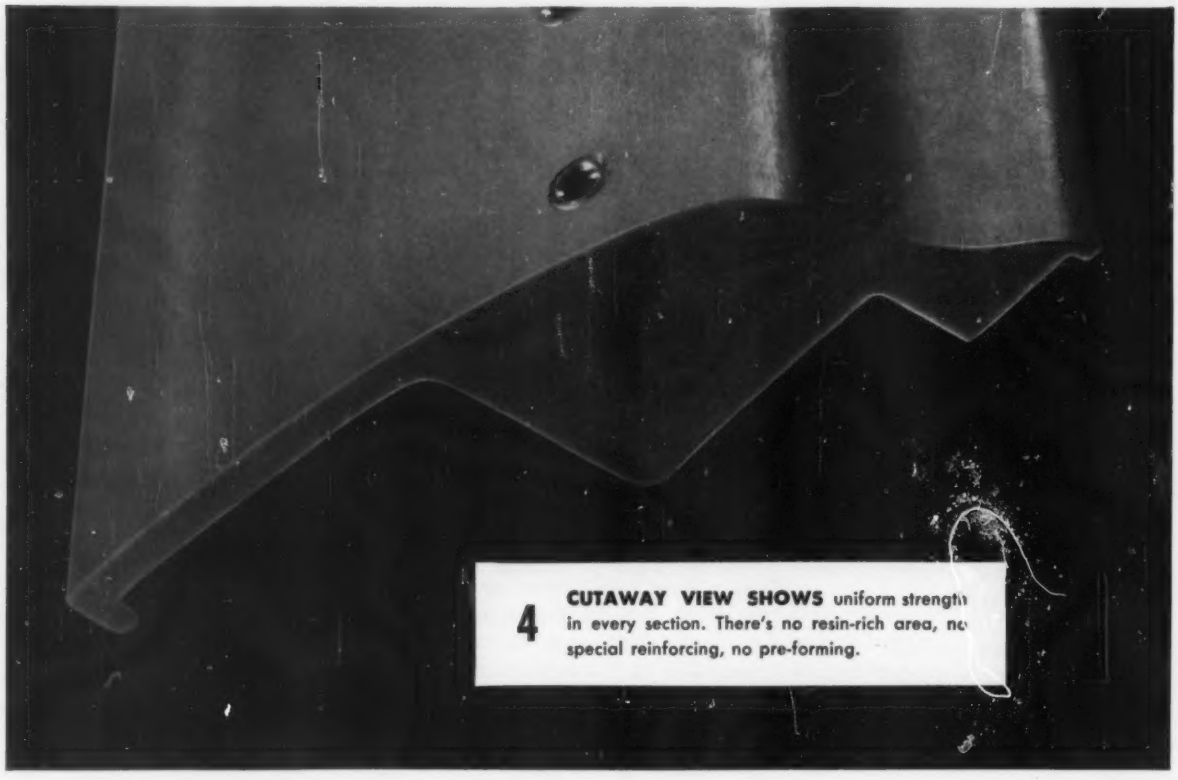
1 This premix consists of reinforcing material, such as fiber glass or sisal, thoroughly mixed with polyester resin containing Dow Styrene.



2 The premix molding compound flows evenly to each and every section of the closed die as it is compressed under heat and pressure.



3 After a very short cycle, the finished premix molding is removed from the die. It is now ready for immediate assembly or shipment.



4 **CUTAWAY VIEW SHOWS** uniform strength in every section. There's no resin-rich area, no special reinforcing, no pre-forming.

For lower bids: premix moldings

For uniform strength: polyester resin with Dow Styrene

Many complicated parts—especially parts with varying wall thicknesses—are now made better, at lower cost, by premix molding. There are no resin-rich areas. Strength is uniformly distributed. Pre-forming is eliminated. And holes and nozzles can be molded in a part, eliminating punching and drilling operations.

Leaders of the automotive and appliance industries have proved the benefits of premix moldings for specific parts. Many innovations are now on the drawing boards.

The product shown is an example of the many now being made by premix molding using Dow Styrene. For technical assistance on Dow Styrene, write THE DOW CHEMICAL COMPANY, Midland, Michigan – Plastics Sales Department PL1886E-2.

Photographs through the courtesy of Fabricon Products, River Rouge, Michigan

YOU CAN DEPEND ON DOW

The Plastiscope

(*Continued from page* 41)

duces electric power, many chemicals, and metallurgical products. Union Carbide now operates or is building polyethylene plants in Canada (capacity 24 million lb.), Scotland (26 million lb.), and Brazil (9½ million lb.).

A revised estimate of last year's polyethylene exports indicates that about 129 million lb. were shipped to foreign countries out of a total sales volume of 510 million pounds. Japan was the largest customer with an estimated 24 million pounds. France was second with about 20 million and Canada was third with 19 million. West Germany imported over 7 million pounds. Sweden took about 7 million, and Belgium around 6 million. The United Kingdom imported about 6 million, but it was mostly for the Bakelite plant in Scotland.

Exports for 1957 are running well ahead of 1956—could total over 170 million lb. for the year, but new import restrictions in Japan will cut severely into the total. A Monsanto spokesman in Tokyo was quoted as saying that the new restrictions can have an adverse effect on the 1-million-lb.-per-month market for his company.

Over-all sales of U. S.-produced polyethylene broke all records in May (last month of record), with 60 million pounds. Total for 1957 is now expected to be at least 650 million but estimates change every month.

Plax Corp. expands. A new plant with 130,000 sq. ft. of space has been acquired by Plax at Ligonier, Ind. Plans call for production of blow-molded containers, polyethylene tubing, and Polyflex (oriented polystyrene film and sheet) at the new location. Manufacture of polyethylene film and sheet will start in August, bottles in early 1958, and Polyflex a year later. The company's present polyethylene film operation in Louisville will be moved to Ligonier. The company has also announced a 5% price reduction in Polyflex for clear material only and in thicknesses of from 2 to 10 mils.

Vinyl stearate producer. Air Reduction Chemical Co. is building a new 2 million lb. vinyl stearate plant at Calvert City, Ky., to be completed in 1958. The material is used in combination with other vinyl compounds in making emulsions as well as in rigid and flexible formulations. Vinyl stearate acts somewhat as an internal plasticizer and is reputed to give flexibility and easier workability to vinyl resins. Such formulations are suggested for the manufacture of water-based paints, adhesives, paper coatings, textile finishes, floor coverings, toys, and insulation for electrical wiring.

Improved modified polystyrene. A new rubber-modified polystyrene with impact strength lying between general-purpose and high-impact styrenes is now available from Bakelite Co. Designated TMDA-8020, this new formulation combines free-flowing characteristics with fast set-up. It is claimed to be as easy to mold as conventional polystyrene, yet to have color stability and chemical and electrical properties similar to those of rubber-modified high-impact styrenes. It is suggested for such items as detergent closures, switch plates, towel racks, and action-type toys.

For additional and more detailed news see Section 2, starting on p. 280

The Case of Careless Casey

Now it can be told. Truth is, mighty Casey got mighty careless that day in Mudvilie. His sweetheart, pretty Polly Popkins, was sitting back of third base, rooting for Casey like all git out. When that last pitch came across the plate, Casey missed it because he was too busy dreaming about Polly.

Here at Boonton, we try to remember that even a crowd pleaser like Casey can get a little careless now and then. So when we're entrusted with a compression or injection molding job, we *always* keep an eye on the ball. To help us, we've got inspection shadow projectors and all other kinds of testing and control equipment. And we stay right with the job, even if it requires going into extra innings. That's why we've made a lot of friends during the past thirty-five years—folks from here to Mudville who look to us for dependable moldings at a fair price.

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Western New York Area—Alden 7134
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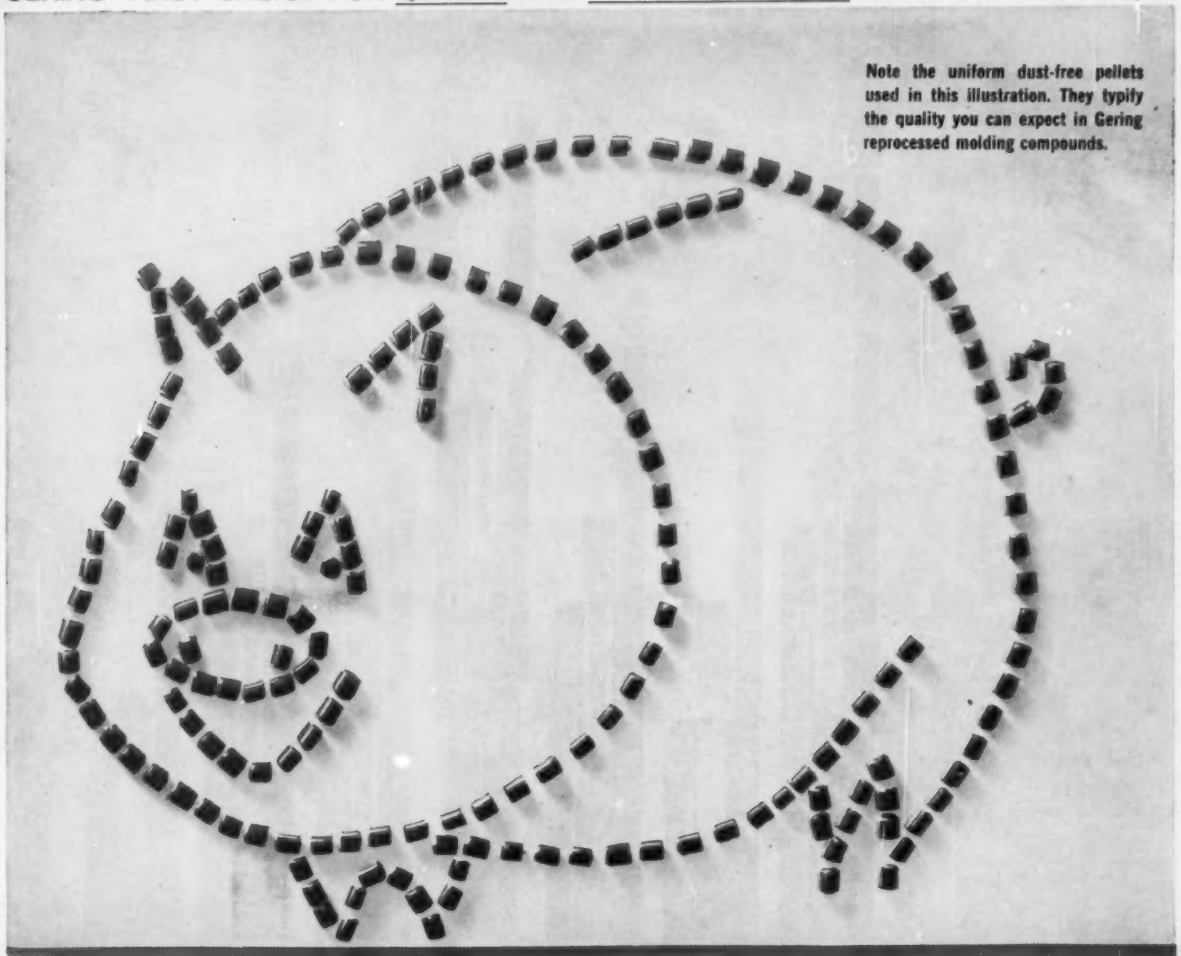

Note the uniform dust-free pellets used in this illustration. They typify the quality you can expect in Gering reprocessed molding compounds.

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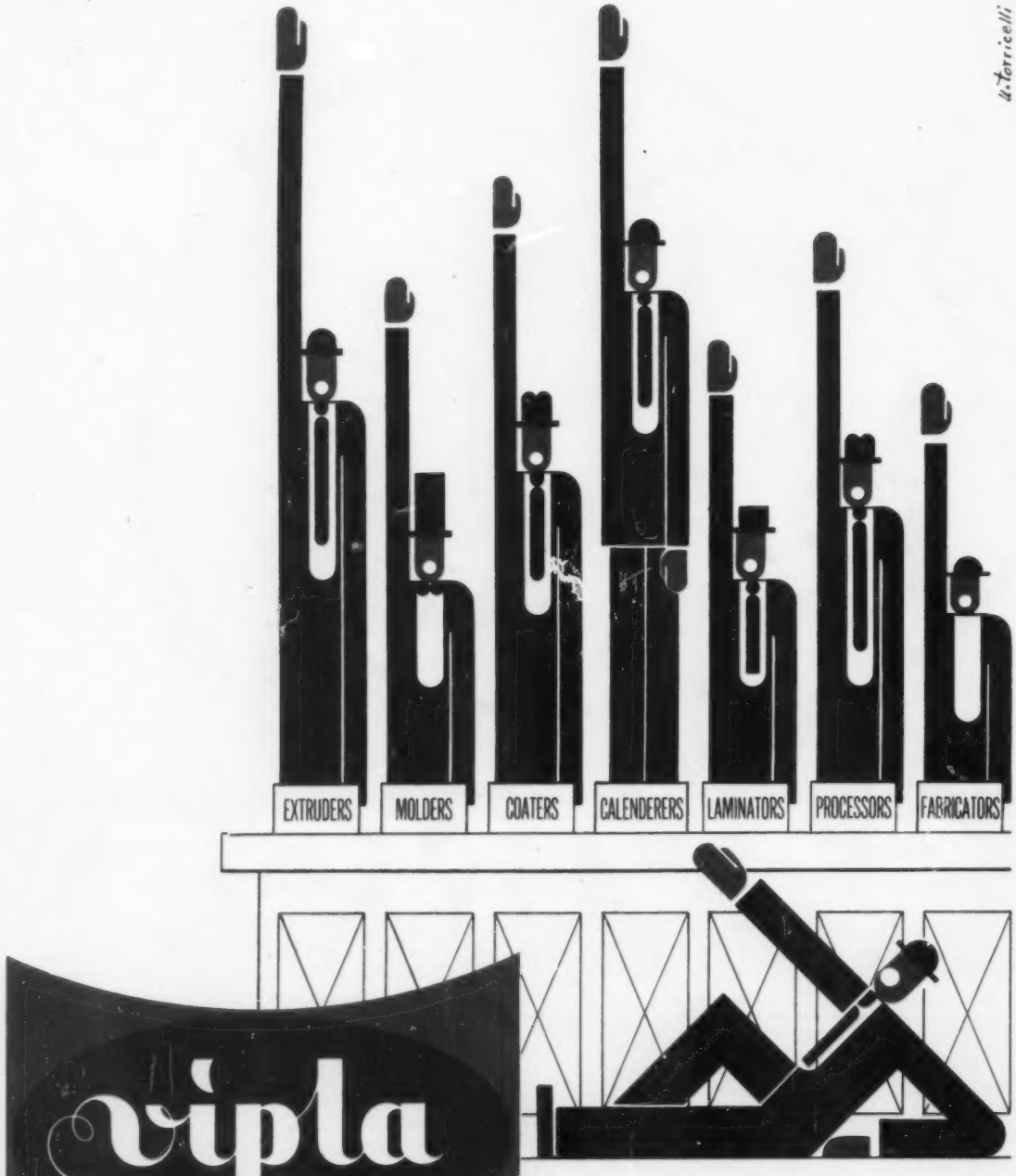

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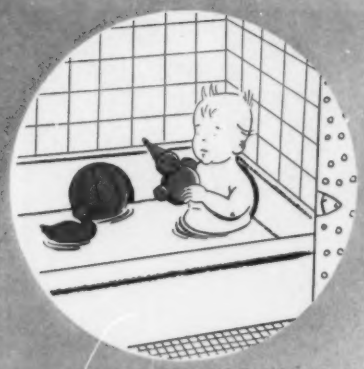

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A Leading Molder Reports —

"A wider plasticizing range and ease of processing are big advantages of Spencer Nylon," reports Cliff Hutchison (center) of Molding Jobbers, Inc. Unique molding problem solved by Spencer Nylon is discussed above by Mr. Hutchison and John Beavens (left) and Byron Carlson (right) of Scott-Atwater.

"Spencer Nylon outperforms other nylons in gear application"

Read how Spencer Nylon 401 ran as high as 90 ft. lbs. in a torque load test requiring 55 to 60 ft. lbs.:

A molding crisis was solved recently when Molding Jobbers, Inc. of Minneapolis took advantage of the special benefits available in new Spencer Nylon.

The story began when Scott-Atwater, makers of outboard motors, designed a new type of gear box involving a remote control gear sector. The use of nylon gears was suggested by Molding Jobbers since nylon is largely self-lubricating, corrosion resistant, and about 20% cheaper than cast aluminum in this application. But the problem was to find a nylon that would stand up under the severe strain and stress to which the gears are subjected.

The first nylon tested failed under tension. Then Spencer Nylon 401 was tested. It was found in a torque load test that Spencer Nylon out performed the other nylons as well as other thermoplastics. In fact, Spencer 401 ran as high as 90 ft. lbs. in a test requiring 55 to 60 ft. lbs. But that's not all:

Other advantages of Spencer Nylon 401 were found by Molding Jobbers. A higher melt viscosity and a broad molding temperature range assured good flow properties, proper cavity fill and ease of molding control.

In addition, Molding Jobbers have found that because of the low moisture content in packaged Spencer Nylon, the old problem of excessive moisture pick-up by the granules when exposed in the hopper was solved. The smaller, more uniform granules of Spencer Nylon 401 give constant feed and improved prepacking and plasticizing.

It's easy to see why Cliff Hutchison, president of Molding Jobbers, is now switching other items in his line to Spencer Nylon. Perhaps there is a place for Spencer Nylon in *your* operation. Spencer resins are designed for a wide variety of processing techniques and applications. For more information, write: Spencer Nylon, Spencer Chemical Company, Kansas City 6, Missouri.

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SPENCER

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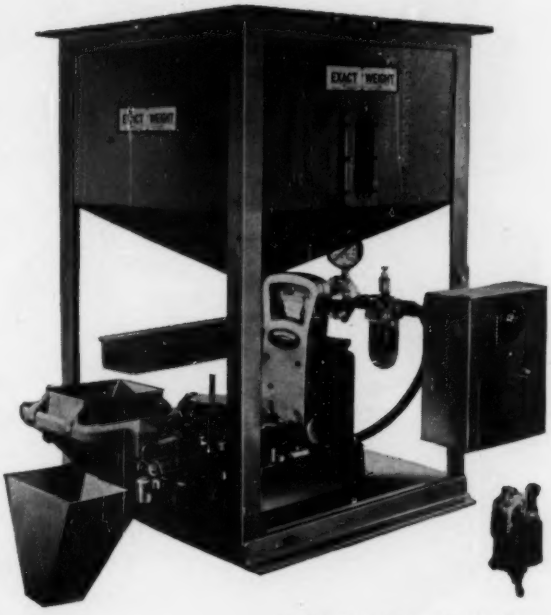
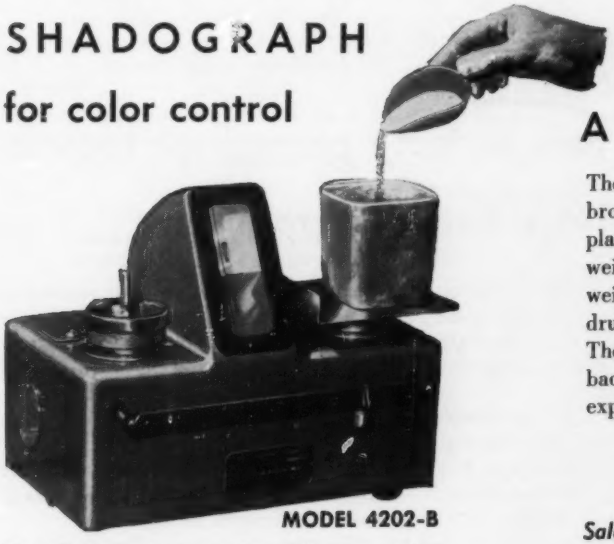
Operation of the Weighing Machine is fully automatic. The new Automatic Plunger Position Control is effective in either starve or cushion feeding with visible weight indication on every charge.

The 1:1 ratio lever system, in a complete precision scale with over-under indication, provides extreme accuracy. Double controls cut off feed to scale following all vibration in the press—no material shakes from feeder pan following cut-off. Air-operated weight bucket eliminates all impact to scale. Fine adjustments, 1/100 oz. or 1/4 gram increments, can be easily made. (Avoirdupois or metric system optional at no extra cost.)



MODEL 610-F-00-IM-2

SHADOGRAPH for color control



MODEL 4202-B

The Shadograph is engineered on a design principle utilizing a projected light beam. The result is fast, ultra-visible weight indication without parallax readings. Weighs accurately in out-of-level positions. Capacities from one gram to 100 pounds. Write for Bulletin 3333.

A model for every need

The models shown on this page represent only two from the broad line of Exact Weight Scales made specifically for the plastics industry. They include specialized models for pre-weighing plastics materials for pre-form production, check-weighing pre-forms, counting parts by weight, bagging and drum filling, color blending, weigh feeding.

These scientific cost and quality control instruments are backed by more than 40 years of industrial scale building experience. Write for complete information.

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BETTER QUALITY CONTROL . . . BETTER COST CONTROL

WITH THIS RESIN... Firestone EXON 480 RESINS YOU MAKE A BETTER BATCH OF "BISCUITS" EVERY TIME!

EXON 480 ... specifically for (tone perfect) phonograph records

typical of the Pin-Pointed Qualities in Exon Vinyl resins

These "biscuits" are compounded of Exon 480, the vinyl resin created specifically for phonograph records. With each, you get a finished recording of high tonal quality and breakage resistance.

Exon 480 combines many production advantages in the blending, fusing, preforming and molding processes. For instance, here's one production economy: Exon 480's higher bulking density speeds banbury output as much as 25%.

You also get high thermoplasticity, good heat and light stability, plus compatibility with the vinyl plasticizers, stabilizers and pigments most often used. No wonder so many record makers specify Exon 480 for better "biscuits" every time. Another example of how Exon's Pin-Pointed Properties match your particular needs.

Exon 480 is just one of the many fine resins in industry's most complete line of versatile vinyls. It is another reason why industry looks to Firestone Exon for engineered answers to its needs.

Consider your own production or product problem. Then, for resin properties pin-pointed to the best answer for you, check with Firestone.

Firestone EXON RESINS

For complete information and technical service, call or write:

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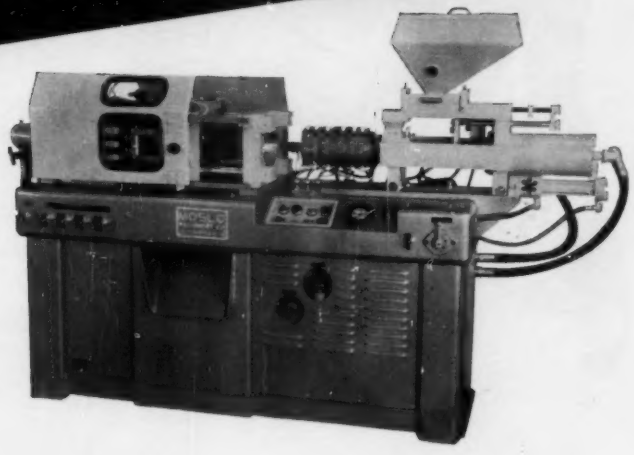
The Moslo DUPLIMATIC—2½ ounce machine designed for high speed production of cord plugs and insert molding. Molds all Thermo-Plastic materials.

MOSLO INJECTION PLASTIC MOLDING MACHINES

Out-produce other machines with TWICE the rated capacity



The Moslo Model 74-7-2—2 ounce injection molding machine**

The Moslo Model 75-8-4—4 ounce injection molding machine**

It may sound unbelievable, but it is a fact that Moslo injection molding machines turn out twice the production of similar competative machines.

Moslo machines are equipped with the latest automatic controls and safety features, are ruggedly constructed for years of continuous running, and operate at speeds that make *production profitable*.

To appreciate fully how a Moslo machine can benefit you, write for complete specification material.

Better yet, make a visit to our headquarters and we will arrange a demonstration using your own molds.

*Hydraulic pull-back for plasticizing assembly is optional equipment on 2 ounce model and standard equipment on Model 75.

**2 and 4 ounce machines available with long stroke clamp for deep-draw work as optional equipment.

MOSLO—The Name for the world's fastest Molding Machines

MOSLO MACHINERY COMPANY

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PLASTICIZERS

...for rugged strength ...added beauty in vinyl flooring

Vinyl flooring plasticized with Benzoflex 9-88 is easier to process, gives a higher gloss and greater durability.

This clear, low-cost, stable, mild-smelling plasticizer–one of eight benzoate esters from Tennessee–imparts many other advantages to vinyl films, foams or tile; to PVA adhesives, coatings, plastisols, waxes and polishes and other products.

It will pay you to investigate the money-saving advantages of Benzoflex plasticizers. For information and samples, write Tennessee Products and Chemical Corp., Nashville 3, Tenn.

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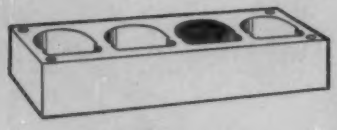
A DIVISION OF THE CHEMICAL, PAINT AND METALLURGICAL DEPARTMENT OF MERRITT-CHAPMAN & SCOTT CORPORATION

Finer plastics begin with BENZOFLEX® *plasticizers from Tennessee*

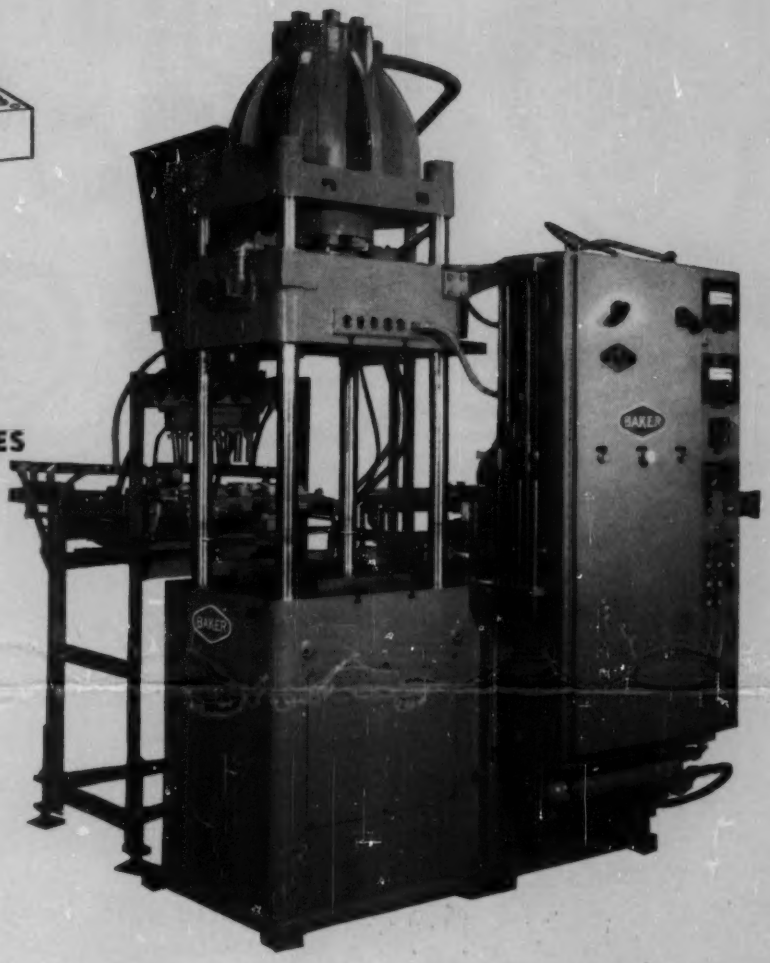
Prevents mold damage! If there is any obstacle in the way, the Baker automatic press does not close far enough to reach a set limit switch . . . never goes to high pressure . . . shuts off automatically. Before buying an automatic press, check whether it has this safety feature. And also ask: Can the same loading cups be used for different molds? Is there spillage of powder? Does the press have independent upper and lower ejection? How about rugged machine tool construction? Does it meet J.I.C. standards? Baker's fully automatic presses give you all this, and are also available with Westinghouse CYPAK controls. Write Baker Brothers, Inc., 1010 Post Street, Toledo 10, Ohio.

If a part doesn't eject, this automatic press stops itself!

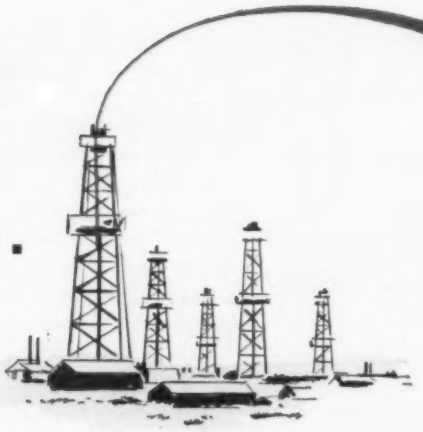


BAKER

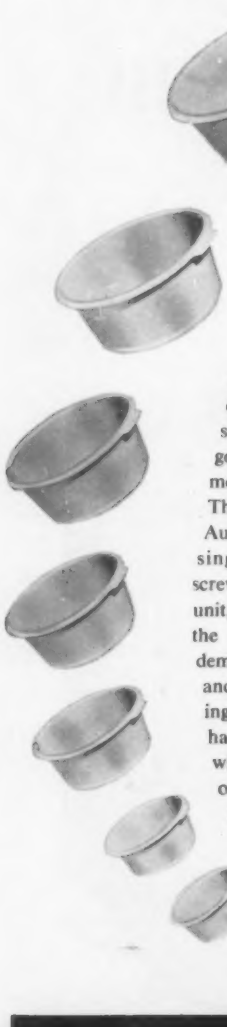
AUTOMATIC
MOLDING MACHINES



IT'S A COMPLICATED PROCESS FROM HERE . . .



. . . TO HERE



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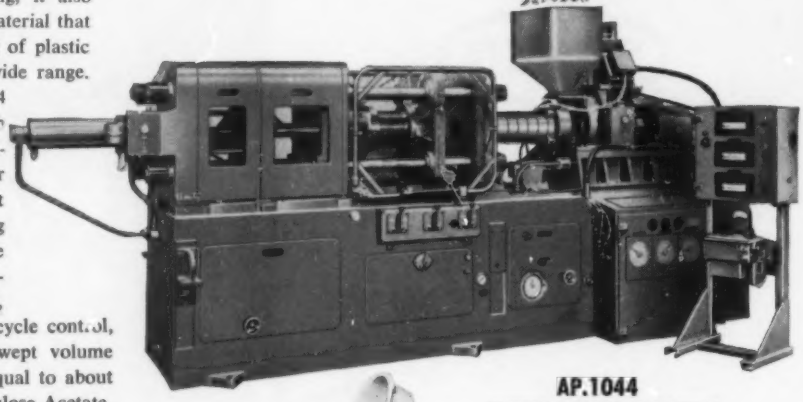

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INJECTION MOULDING MACHINE

Descriptive literature on our full range of machines is available on request.

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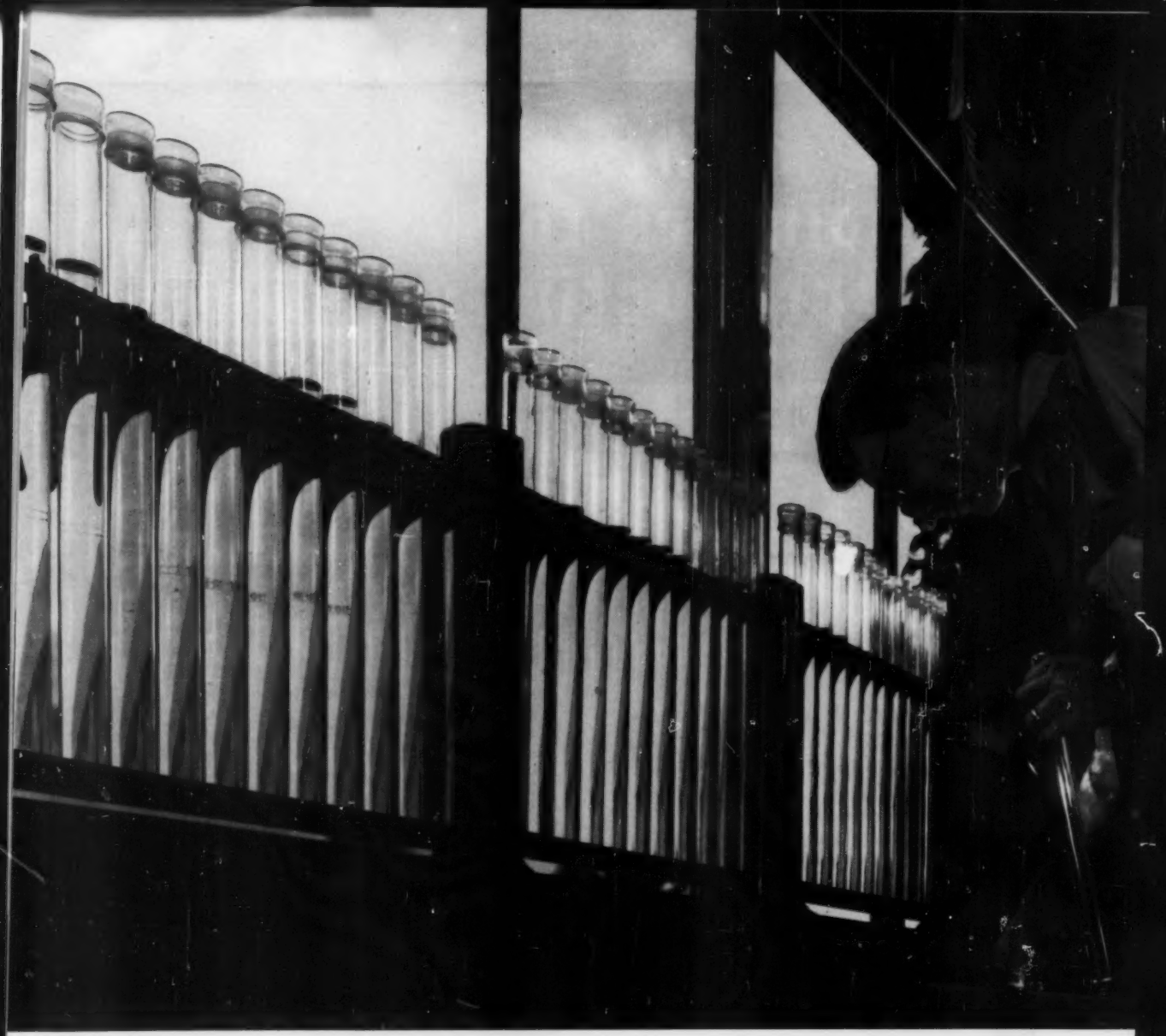

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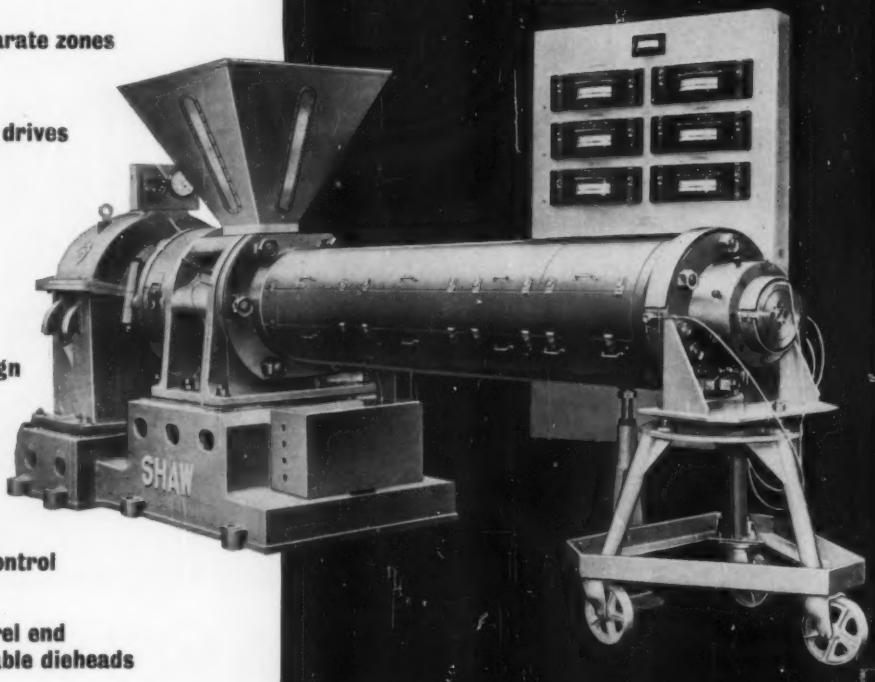

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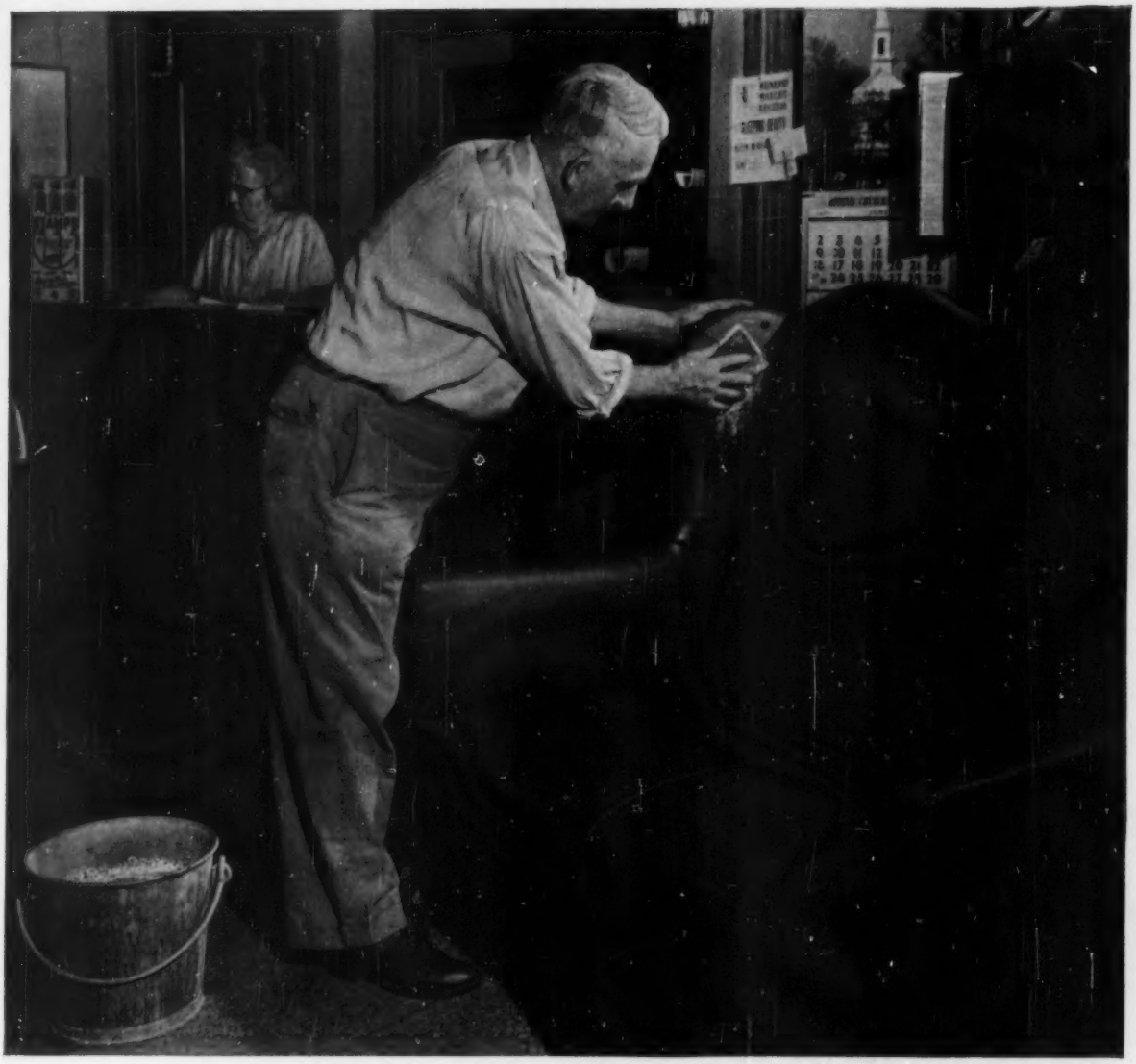

PARAPLEX G-50

...gives durability to vinyl upholstery

Even long, hard service and frequent cleaning does not take out the plasticizer . . . nor affect the like-new flexibility and toughness of vinyl upholstery plasticized with PARAPLEX G-50.

Providing long service life is one of the most important factors in formulating vinyl films for furniture and upholstery, automotive, or other vinyl products exposed to perspiration, soiling, oils and water. Are you sure *your* vinyl products will meet the tests of long service?

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plastic

MOLDING MACHINES

features

- ✓ Fully automatic horizontal type.
- ✓ Straight hydraulic clamping.
- ✓ No need of hazardous adjustment of stay nuts.
- ✓ Long straight heating cylinder allows quick and uniform plasticizing.
- ✓ Special clamping of heating cylinder makes exchange possible in but a few minutes.

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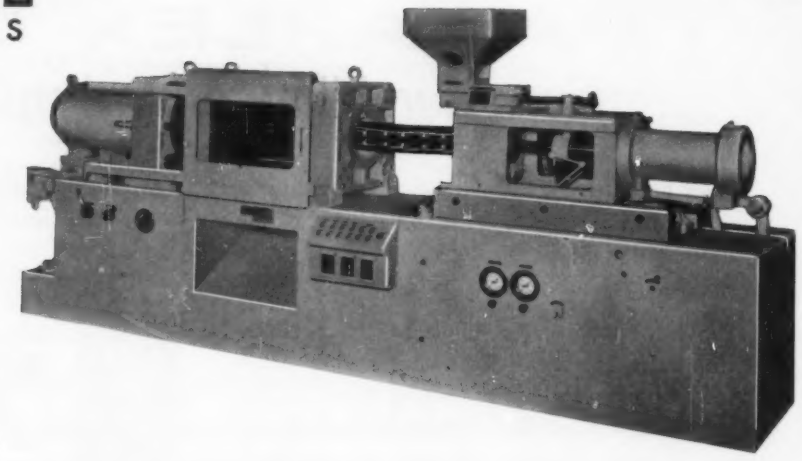

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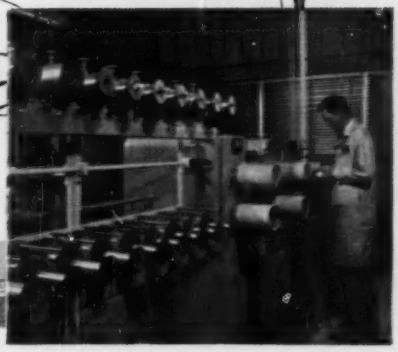
MARLEX 50 monofilaments are easily extruded. They combine exceptional strength with low elongation. You can color them as brilliantly as a peacock's plumage, yet they will not stain. Never before have you had a fiber available which could do so much at such low cost. And talk about durability! MARLEX 50 fabrics can face the rigors of life in home and commercial laundries. Dry cleaning holds no terrors either, for MARLEX 50 textiles come up smiling every time.



Our new Sales Service Laboratory in Bartlesville, Oklahoma has one aim in life: to help you make the most of versatile MARLEX 50 polyethylene. Whatever your potential application, our staff is at your service. For more information, ask our Plastics Sales Representative who calls on you. Or get in touch with our nearest District Office listed below.

Filaments are extrusion-drawn under carefully controlled conditions at our Sales Service Laboratory. Here we can show you how to "tailor make" MARLEX 50 filaments for dimensional stability at elevated temperatures and with desirable stress-strain properties. Yarns and fabrics can be manufactured from this new plastic with conventional equipment and techniques.

Shoe uppers, indoor and outdoor upholstery, shower curtains, draperies, sailcloth, fishnets, tarpaulins, filter cloths, and rubber reinforcement are but a few of the attractive textile uses for this unique new filament of MARLEX 50 polyethylene. In cordage, MARLEX 50 is adapted for many applications, from a surgeon's suture to hawsers on the towing bitts of a tug.

*MARLEX is a trademark for Phillips family of olefin polymers.

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of the products you make

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. . . essential for uniformity plus strength

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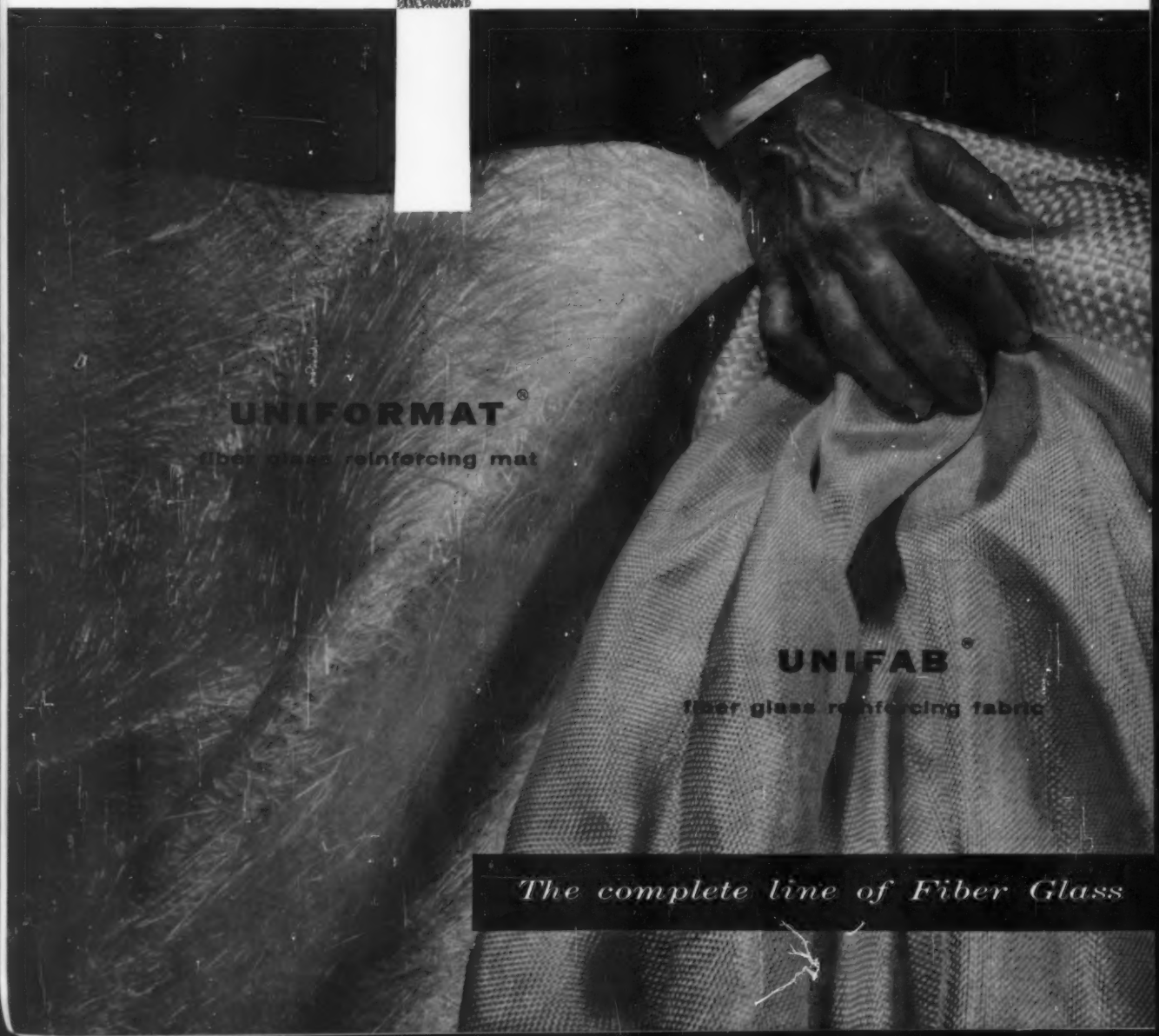

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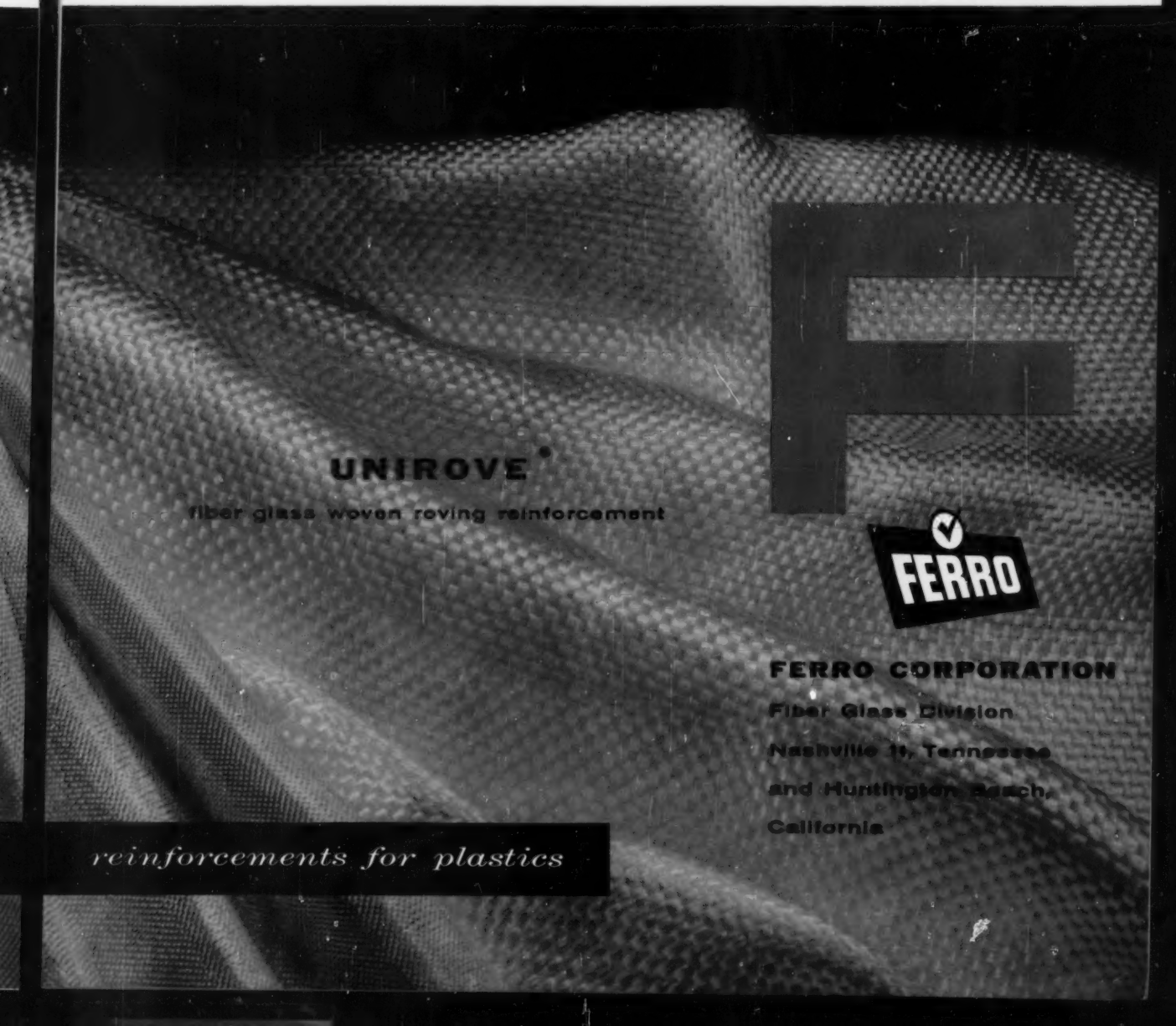
Uniformity, plus the degree of strength you must have, is here in this complete line of fiber glass reinforcements. Produced—from basic materials to finished product—by Ferro, under continuous quality control.

Uniform weight. Uniform thickness. Uniform weave or texture. Every roll you receive must conform to your "specs." Each has been Ferro checked throughout production. Periodical double checks prove strength and performance in finished products. You see this proof in fewer rejects, smoother production.

Write for samples, prices and specifications.



FERRO HIGH FIDELITY COLOR

. . . the economical way to <u>romance</u> the quality of products you make

Let the colors you select speak for the quality and sales appeal you want your products to reflect. Any color you desire is possible through Ferro's high-fidelity color service. A service that develops and matches colors you specify, then lab-checks these colors under production conditions for uniformity.

We control-check each color before we ship!

To save money on materials, inventory and waste,

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use Ferro dry or paste colors to color clear resins in your own plant. Ferro will help you work out sound techniques, without the need for expensive equipment.

Write for complete information about the Ferro high-fidelity color service, and how it can help you add romance to the products you make.

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. . . to transform the usual product

into the unusual

It takes only small amounts of the right kind of Ferro stabilizers to add unusual quality to vinyl products, improving heat and light stability and resistance to sulfur staining. Ferro stabilizers also add physical properties desired during processing.

Ferro will work with you to perfect formulations that fit your needs. We offer a complete line of stabilizers and have developed many formulations that have transformed the quality of usual products into the unusual . . . adding significantly to customer satisfaction by increasing product service life.

Write for complete information and specific formulations.

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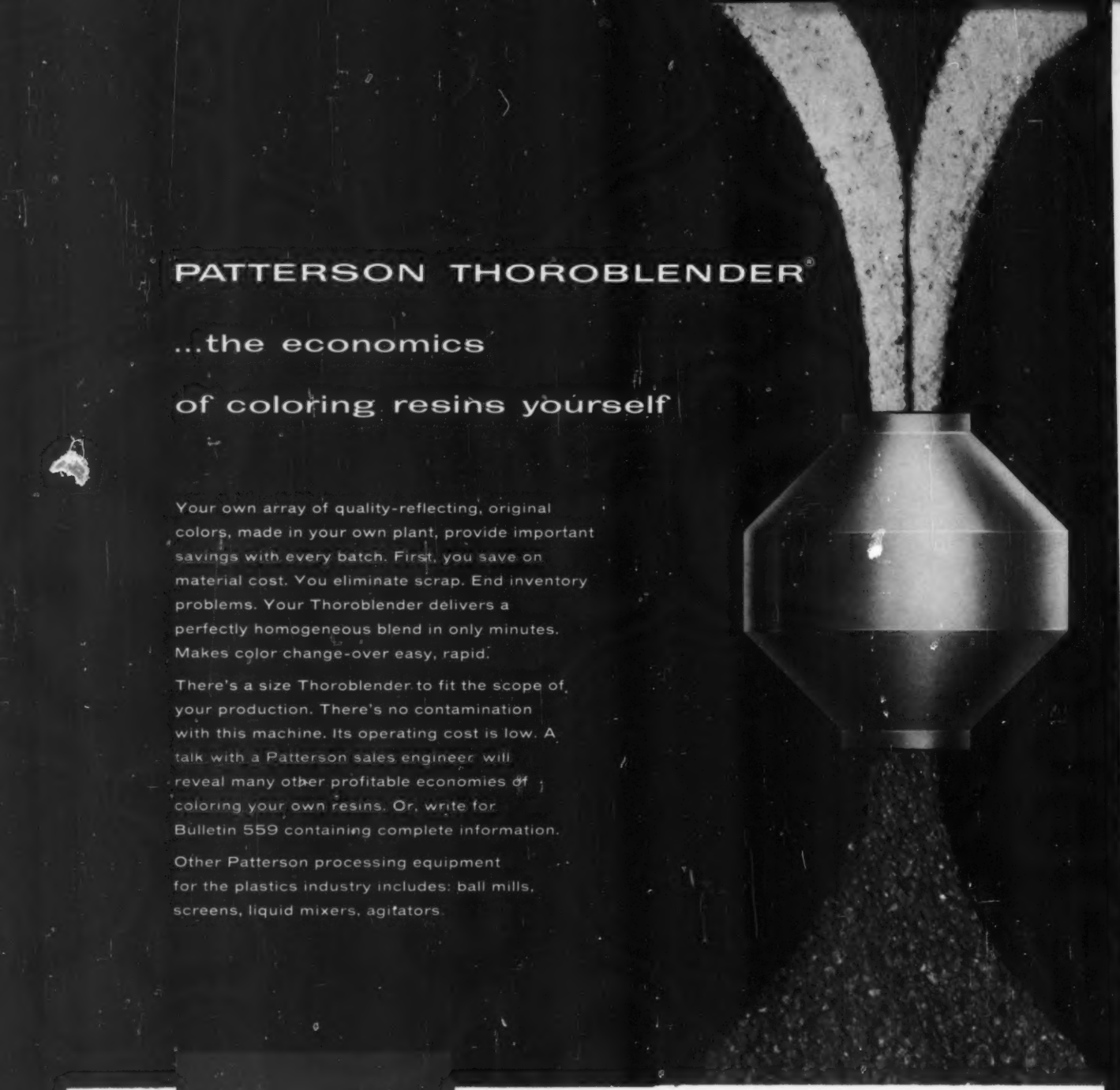
IN GREAT BRITAIN AND ON THE CONTINENT (EXCEPT GERMANY) FERRO VINYL STABILIZERS ARE MANUFACTURED AND DISTRIBUTED UNDER LICENSE BY PURE CHEMICALS LTD., KIRKBY INDUSTRIAL ESTATE, LIVERPOOL, ENGLAND



PATTERSON THOROBLENDER®

...the economics of coloring resins yourself

Your own array of quality-reflecting, original colors, made in your own plant, provide important savings with every batch. First, you save on material cost. You eliminate scrap. End inventory problems. Your Thoroblender delivers a perfectly homogeneous blend in only minutes. Makes color change-over easy, rapid.

There's a size Thoroblender to fit the scope of your production. There's no contamination with this machine. Its operating cost is low. A talk with a Patterson sales engineer will reveal many other profitable economies of coloring your own resins. Or, write for Bulletin 559 containing complete information.

Other Patterson processing equipment for the plastics industry includes: ball mills, screens, liquid mixers, agitators.

Advanced Process Equipment of Enduring Satisfaction

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THE PATTERSON FOUNDRY AND MACHINE COMPANY

A subsidiary of Ferro Corporation, East Liverpool, Ohio, U. S. A.

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"NRC VACUUM COATERS INCREASE PRODUCTION UP TO 50%"

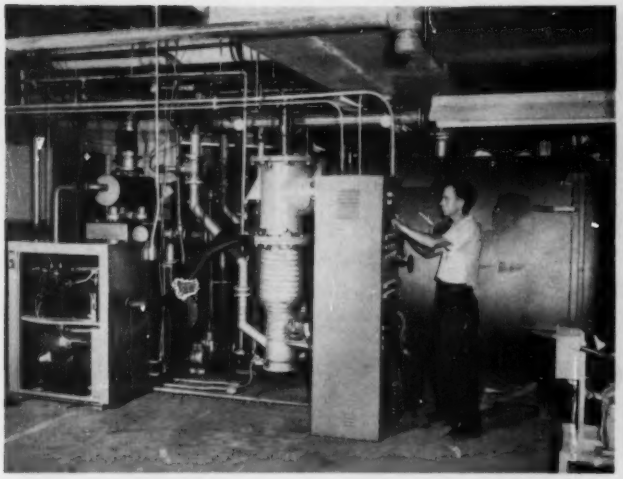
. . . *says Jack Selsemeyer*
Production Manager, Kent Plastics
Evansville, Indiana

"The improvements in the NRC Vacuum Coaters have helped increase production up to 50% and have reduced rejects materially. Our problems with high humidity have practically been eliminated.

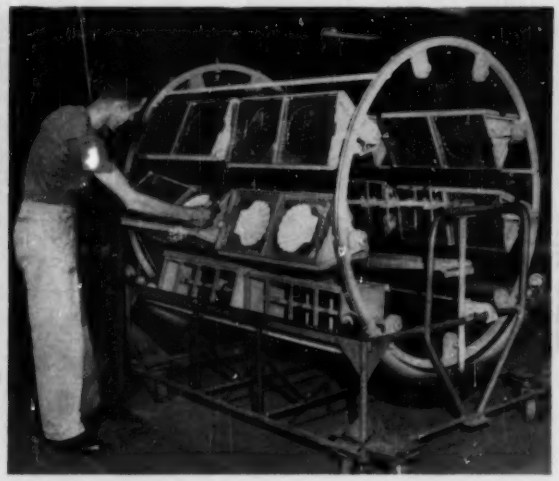
"In dry weather we can complete a cycle in about 15 minutes and in humid weather about 20 minutes. This is about half the time that it took before the latest NRC Equipment was installed.

"In addition, we are getting brighter shots and fewer items are scrapped. Also, with the 5½′ x 5′ plating chambers, greater capacity is realized. The planetary jigs take better advantage of the space in the plating machine. Three times as many items can be plated as in our old equipment."

You too can avail yourself of the advanced knowledge and experience of NRC Equipment Corp. in the field of high vacuum coating. Write today for information about how we might be able to help you cut your finishing costs and improve quality.



"Fewer pieces have been scrapped and production increased with NRC Equipment. This firm has been a real help to us through their highly specialized knowledge in this field" — *Jack Selsemeyer.*



Planetary jigs make best use of space. The arrangement permits three times more pieces to be handled per load than in former equipment.

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MELAMINE HAS MANY FACES...

NEW CHESS SET IS TRANSFER-MOLDED PLASKON® MELAMINE . . . UNITS ARE PERFECT IN DETAIL, DUPLICATE THE "FEEL" AND APPEARANCE OF COSTLY IVORY

Sculptor Peter Ganine, creator of the Superba Chess Set, found that only Melamine offered the exact properties he sought for his prize-winning chessmen. He says, "I tried many possibilities . . . wood, ivory and other plastics. But Melamine was just right. It has many virtues for the chess players. It is pleasant to touch, can be molded in light colors such as off-white and Chinese red, it is virtually unbreakable . . . and lends itself to mass production without appearing to be mass-produced."

In this demanding transfer-molding job, PLASKON Melamine again proves its outstanding versatility. It has the weight and solidity of thermosetting plastics. Like all products molded of Melamine, these chessmen have a hard, durable surface that is scratch-resistant and unaffected by common solvents, soaps, oils and greases. What's more, its color is *molded in* . . . won't chip, crack or peel. And PLASKON Melamine offers an amazing selection of over 12,000 colors.

Other advantages of PLASKON Melamine: excellent electrical properties; suitability for compression and plunger molding as well as for transfer molding. If you are looking for a material that can give your products extra sales appeal and durability . . . try PLASKON Melamine. Additional data and specifications from: BARRETT DIVISION, Allied Chemical & Dye Corporation, 40 Rector Street, New York 6, N. Y.

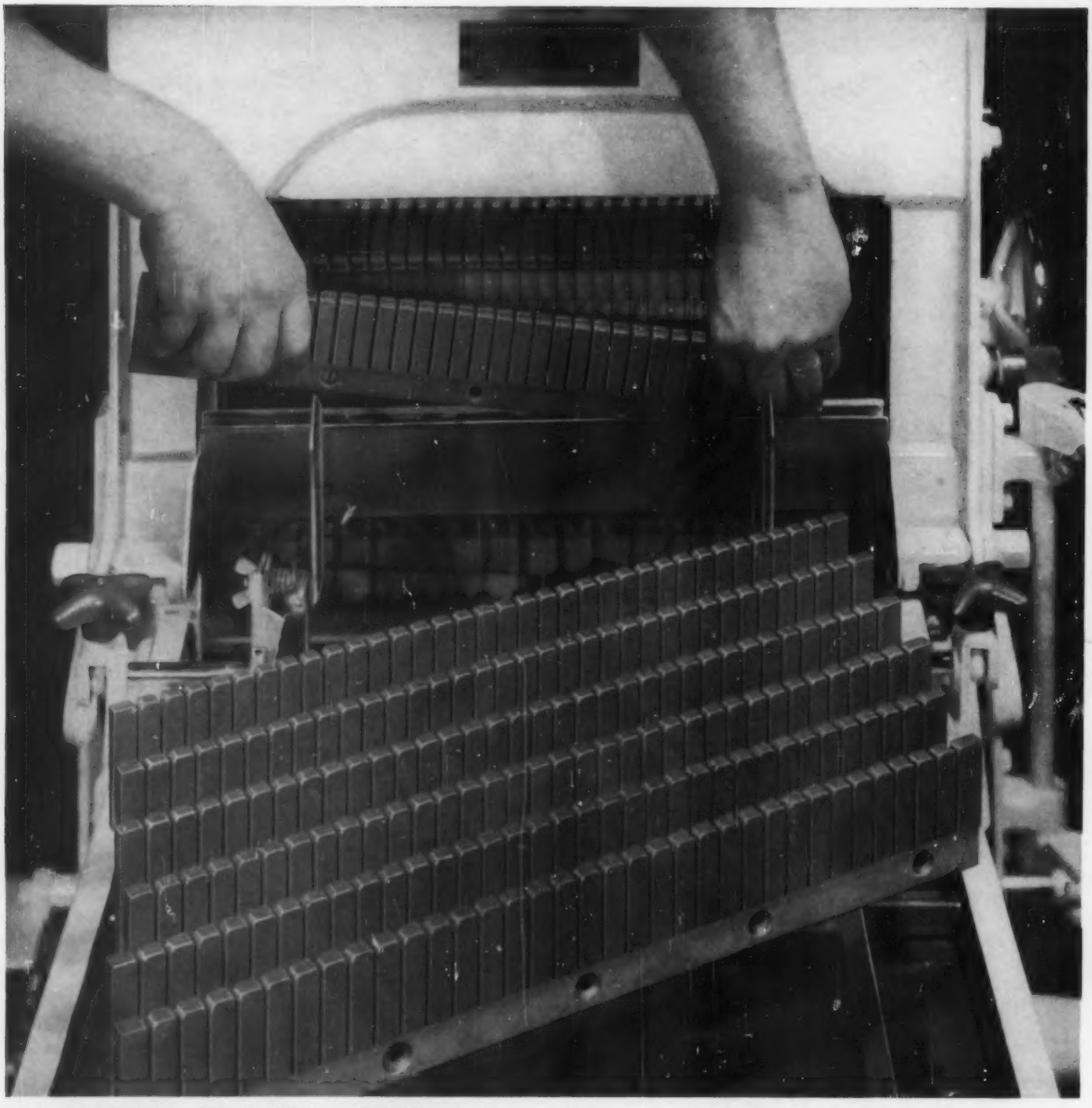
Allied Chemical

PLASKON® MELAMINE

Barrett PLASKON

Chess Set © P. Ganine

NYLON · UREA · MELAMINE
POLYESTER RESINS · ALKYD · COATING RESINS



NO MATTER HOW YOU SLICE IT—The equalizer blade guide bearings for this AMF Micro Jr. Reciprocating SLICE MASTER—a commercial bread slicer manufactured by American Machine and Foundry Company—required a highly specialized material for several extremely important reasons. First of all, the bearings had to be self-lubricating, yet able to withstand considerable heat caused by friction. Secondly, they had to be strong and wear-resistant, but could not dull the blades with which they came in contact. Finally, the bearings had to be easy to clean to avoid contamination of edible materials. For this particular job, AMF selected Synthane—a laminated plastic made and fabricated by Synthane Corporation and in which Mount Vernon fabrics were used.

This is another example of how fabrics made by Mount Vernon Mills, Inc. and the industries they serve, are serving America. Mount Vernon engineers and its laboratory facilities are available to help you in the development of any new fabric or in the application of those already available.

UNIFORMITY Makes The Big Difference In Industrial Fabrics

Mount Vernon Mills, inc.

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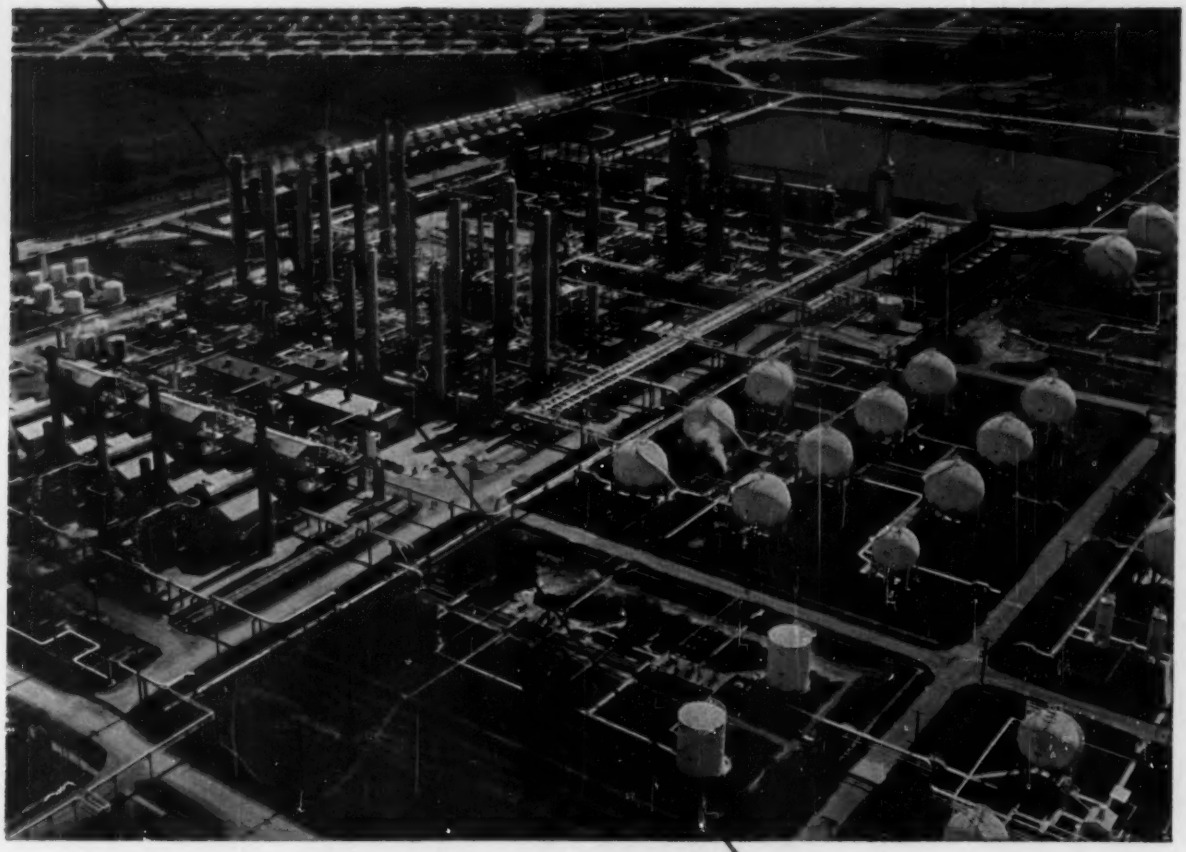
Butadiene Capacity Now 200,000 tons/year



Here you see America's largest non-captive butadiene plant which can now produce 200,000 tons per year to meet the growing needs of the rubber, fiber and chemical industries.

Addition of new butane dehydrogenation units (top center of photo) and related equipment has materially increased both the capacity and flexibility of our Houston plant. A new fleet of tank cars and a modern Research Laboratory and Pilot Plant have also been added to our facilities.

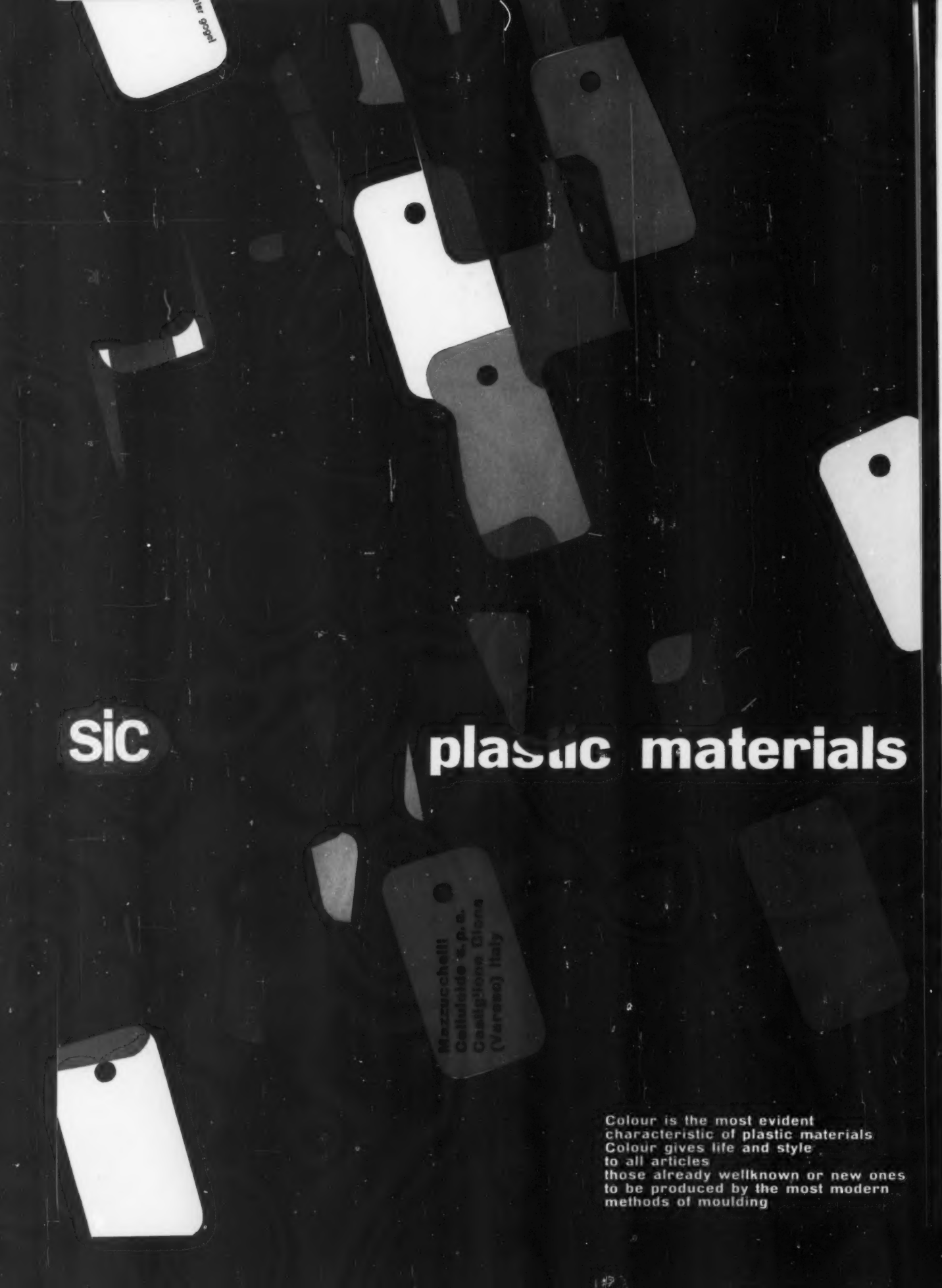
Now Petro-Tex is in a better position than ever before to work with producers of end-products and intermediates in the plastics, fibers, coatings, films, adhesives, lattices and elastomers fields. We welcome discussion of your needs for butane-derived hydrocarbons.

PETRO-TEX CHEMICAL CORPORATION

HOUSTON 1, TEXAS

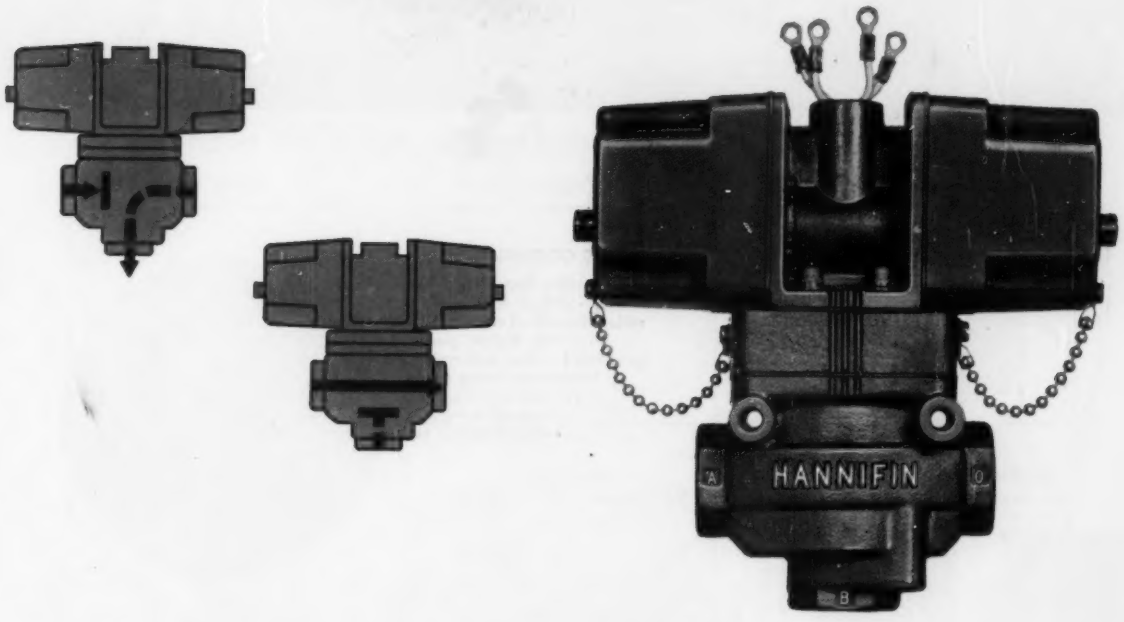
JOINTLY OWNED BY

FOOD MACHINERY AND CHEMICAL CORPORATION AND TENNESSEE GAS TRANSMISSION COMPANY


SIC
plastic materials
Colour is the most evident
characteristic of plastic materials
Colour gives life and style
to all articles
those already wellknown or new ones
to be produced by the most modern
methods of moulding

Setting the pace for automation

...Hannifin valves



Automatic processes call for speed, sensitivity and flexibility in directional air control. Above all, they demand dependability. That is why so many valve users find it pays to choose Hannifin.

Every feature that contributes to dependable performance has been incorporated in Hannifin air control valves. This dependability is the result of never-ending research and development.

In the broad Hannifin line, you will find valves with new exclusive features... valves for practically any kind of automatic sequential operation. All are simple in design, with few and easily replaceable parts.

AIR CONTROL

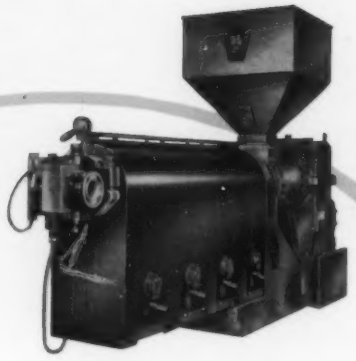
HANNIFIN

VALVES

For this complete catalog showing all the Hannifin directional air control valves, write to Hannifin Corporation, 553 South Wolf Road, Des Plaines, Illinois.

the big 3 in pipe extrusion

DAVIS-STANDARD'S THERMOPLASTIC PIPELINE

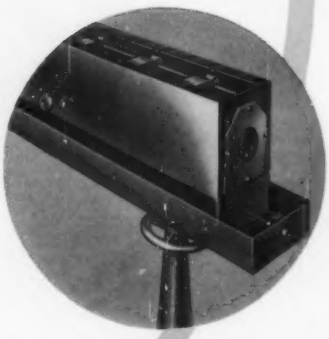


D-S EXTRUDERS

THERMA-FIN ® **Extruders* for plastic pipe in bore sizes from 1-½" to 6" for pipe diameters from ⅜" to 6". The unique Therma-Fin temperature control system assures consistent, high quality pipe delivery over a wide range of operating conditions.**

D-S COOLING TROUGHS

Continuous cooling through a 5 foot sizing-cooling tank and a series of sectional cooling tanks. Sectional design permits graduated water temperatures to give best curing results. Pipe can be completely immersed in water or cooled by spray jets.



D-S CATERPILLAR HAUL-OFFS

Model LDC is a heavy-duty pipe Haul-Off with variable speeds up to 100 feet per minute. This unit handles pipe sizes ⅜" to 6" with gripping pressure uniformly distributed over a 2' length. Rocking action of treads maintains constant, uniform gripping pressure when irregularities in cable surface occur.

*Patented

DAVIS-STANDARD

Division of FRANKLIN RESEARCH CORPORATION

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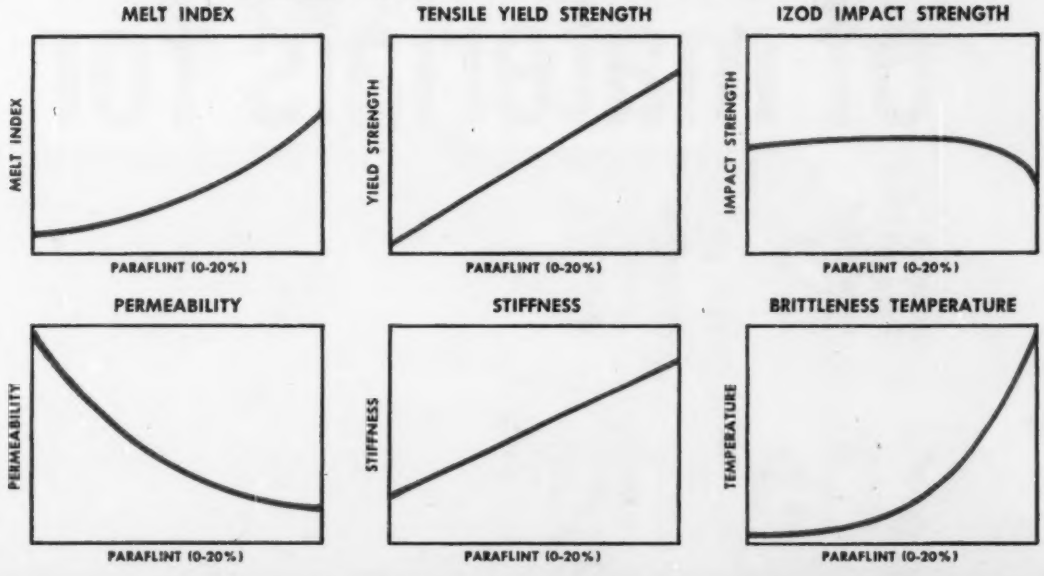
for product improvement

Recently completed tests of PARAFLINT blended with polyethylene demonstrate the versatility of this new low cost synthetic wax. Formulations containing up to 15% PARAFLINT indicate that improvement in tensile yield strength, stiffness, gloss and permeability can be obtained. PARAFLINT raises the melt index of Polyethylene, enabling faster molding cycles without flow stresses, and permits lower molding temperatures, thus reducing thermal breakdown.

HOW PARAFLINT MODIFIES POLYETHYLENE



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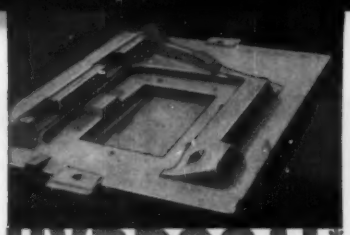
Now, you're assured of unit responsibility; of quality materials that have been scientifically researched, thoroughly tested. A qualified U.S.G. technician will be happy to demonstrate how these U.S.G. materials can be applied to your plastic tooling problems.

FREE! Write United States Gypsum, Dept. 122, 300 West Adams St., Chicago 6, Ill. for this free literature: HYDROCAL Models and Molds (IGL-ITT-100); Vacuum Forming with ULTRACAL (IGL-ITT-55); EPOXICAL Laminating Resin (IGL-400); EPOXICAL Casting Resin (IGL-401).

UNITED STATES GYPSUM



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HYDROCAL gypsum cements are used for molds and original models to laminate or cast plastic patterns, dies, jigs, fixtures or foundry match plates and core boxes.

ULTRACAL*

ULTRACAL gypsum cements are used for vacuum forming models and molds. Offer high strength, improved heat resistance for prototype, short run and production applications.

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NEW EPOXICAL tooling plastics permit laminating or casting of precise, economical epoxy resin patterns and models in half the time required by traditional techniques.

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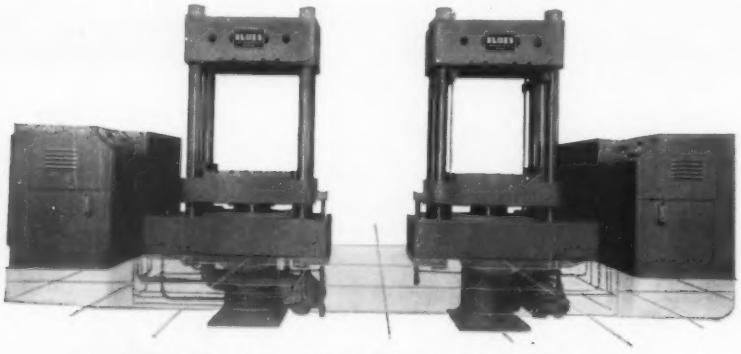
"Job-Fitted" HYDRAULIC PRESS

Is a "troublesome shape" getting you in a squeeze? Tough production problems involving unusual shapes are often "old hat" to Elmes engineers—situations made to order for Elmes ingenuity in helping with consultation and recommendations.

Sometimes a standard design Elmes® Press, or a simple adaptation of it, will handle the customer's requirements. Sometimes the work to be performed involves development of a special custom-built press. But, *whatever it takes,* Elmes is equipped to provide *the right press for the job!*

It just makes sense to take advantage of the best of someone else's experience—particularly when it is backed up by more than 60 years of leadership in specialized hydraulic service. Whatever your pressing problem, it will pay you to call in Elmes. See your nearby authorized Elmes distributor, or write to us direct.



Compact installation of Elmes 300-ton Compression Molding Presses with controls and top knockouts arranged so that one operator can handle both presses. Elmes standard and special designs include presses for compression or transfer molding operations, hot-plate laminating, or reinforced plastics molding.

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PLASTICS INDUSTRY DISCOVERS THE NITROPARAFFINS!

Among the most successful of the NEW Chemicals for plastics are the Nitroparaffins . . . Nitromethane, Nitroethane, 1-Nitropropane and 2-Nitropropane . . . and their many derivatives.

In addition to their present importance as solvents for compounding and finishing plastics, the Nitroparaffins are a source of many polyfunctional molecules of interest in the manufacture and improvement of plastics.

Trained technical representatives may be reached at any CSC sales office for work on your specific product or processing problems. Or, write for specific application information, technical data sheets and samples.

Versatile NP's and Derivatives In Large-Scale Production

VINYL RESINS AND COPOLYMERS: *Nitroparaffins* — Are good solvents for polyvinyl acetate and many of the vinyl chloride-acetate polymers. They have the advantage over the ketones of allowing higher solids content at no increase in cost. Also, there is less solvent retention in the film where Nitroparaffins are utilized and much less of an odor problem. *Nitromethane* in the presence of toluene is the most powerful solvent of the group.

EPOXY RESINS: *1-Nitropropane and 2-Nitropropane*—Are outstanding solvents for epoxy resins, giving high solids, low viscosity and greatly improved flow characteristics at no extra cost.

UREA-FORMALDEHYDE RESINS: *2-Amino-2-methyl-1-propanol (AMP)*— Used as a stabilizer for urea or melamine formaldehyde finishes.

2-Amino-2-methyl-1, 3-propanediol (AMPD) — Used as a catalyst for making urea-formaldehyde resins.

ALKYD RESINS: *2-Amino-2-methyl-1-propanol (AMP)* — Viscosity stabilizer in alkyd finishes containing urea-formaldehyde or melamine resins.

Tris Amino — Potentially useful in manufacture of alkyd resins.

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POLYURETHANES: *Hydroxylamine* — Can be used in the preparation of isocyanates by forming the hydroxamic acid and reacting it with an acid chloride.

MISCELLANEOUS: *Alkaterge-C* — As a mold lubricant in the molding of plastics. Excellent grinding assistant for hard resins, and as an antifoam agent in polyethylene coating compositions.

Nitrohydroxy Compounds — As hardening agents for proteins such as casein. They are slower gelling than formaldehyde or glyoxal. *Tris Nitro* is the product most often used, although *2-Nitro-2-methyl-1-propanol* and *2-Nitro-2-methyl-1, 3-propanediol* are also effective.

DISCOVER THE NITROPARAFFINS!

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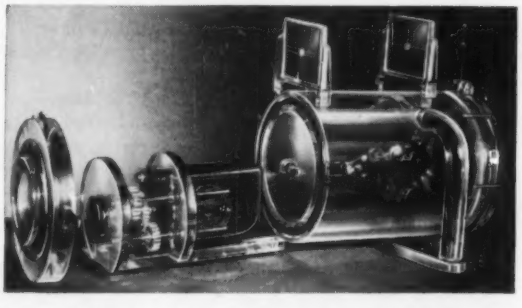
'Perspex' helps to picture the silent world

Photographing nature's deep water secrets sets special problems for camera design. That is why 'Perspex', the versatile I.C.I. acrylic sheet, has been used for this entirely new underwater camera case, designed and manufactured by Stanley Plastics Ltd., Chichester.

'Perspex' eliminates completely the disadvantages of a conventional metal case - corrosion, condensation and obscured visibility. A full system of 'extended control' means that the camera can be operated with greater ease under water; and the prototype has been successfully tested at depths down to 200 ft. at a pressure of 95 lbs. per sq. in. The case is adaptable to nearly all types of camera.

This 'Perspex' ciné camera case is only one example of the way research is developing the use of I.C.I. plastics in all branches of industry.



This exploded view of the new underwater camera case shows the strips of fluorescent 'Perspex' framing the sights, here in the erect position. The clarity of the 'Perspex' cylindrical case allows lens settings to be seen without the provision of external markings or click stops.

'PERSPEX'

is the registered trade mark for the acrylic sheet manufactured by I.C.I.

IMPERIAL CHEMICAL INDUSTRIES LIMITED

Plastics Division: Export Dept., Black Fan Road, Welwyn Garden City, Herts.

U.S.A. enquiries to: J. B. Henriques Inc., 521 Fifth Avenue, New York 17, N.Y.

Canadian enquiries to: Canadian Industries Ltd., Plastics Dept., Box 10, Montreal, P.Q.

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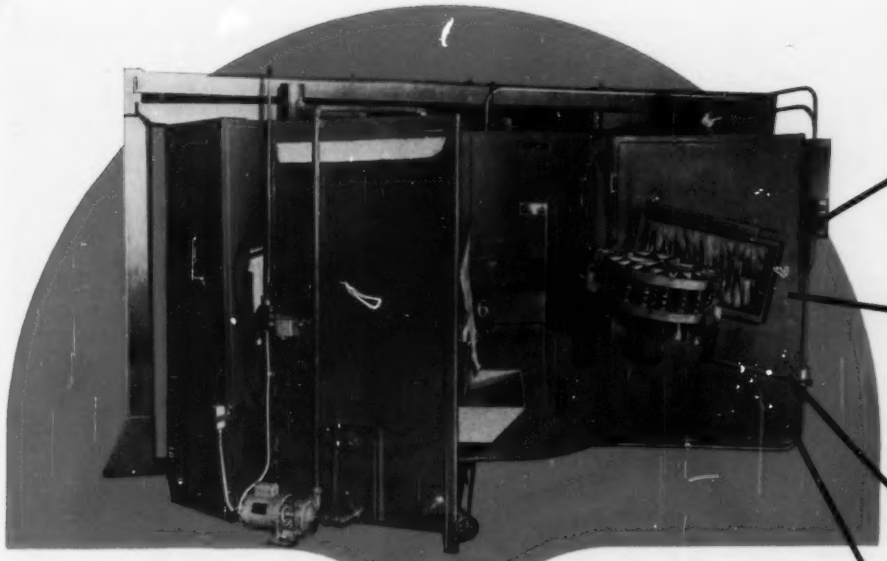

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PRESTO . . . PRODUCTION and PROFITS!

Yes, it seems like magic the way this machine converts raw material into finished goods, in one continuous operation. With only one man at the controls, polyvinyl chloride plastisols are automatically dispensed and rotationally molded to shape, completely controlled by the automatic features of the machine. The operator need not be a technician, because all the plastisols are scientifically prepared, using all the technological advances made by the nation's foremost companies. Now, any hollow article can be molded from polyvinyl chloride plastisols, thus creating countless new product possibilities. With a high hourly production and a low hourly cost, it naturally follows that units produced on this machine are BIG PROFIT items.

LET US SHOW YOU HOW TO DO IT!

We want to demonstrate our "magic" to you. Visit our plant and let us mold YOUR PRODUCTS, right before YOUR EYES . . . like "magic".

Write or call for detailed data or an appointment.

NOW . . . even BIGGER!

Machines are now available with a 15", 25" and 75" molding area, able to mold items *eight times larger* than previously thought possible. Items such as the unicorn, shown here. Imagine, it's automatically molded, in one operation!

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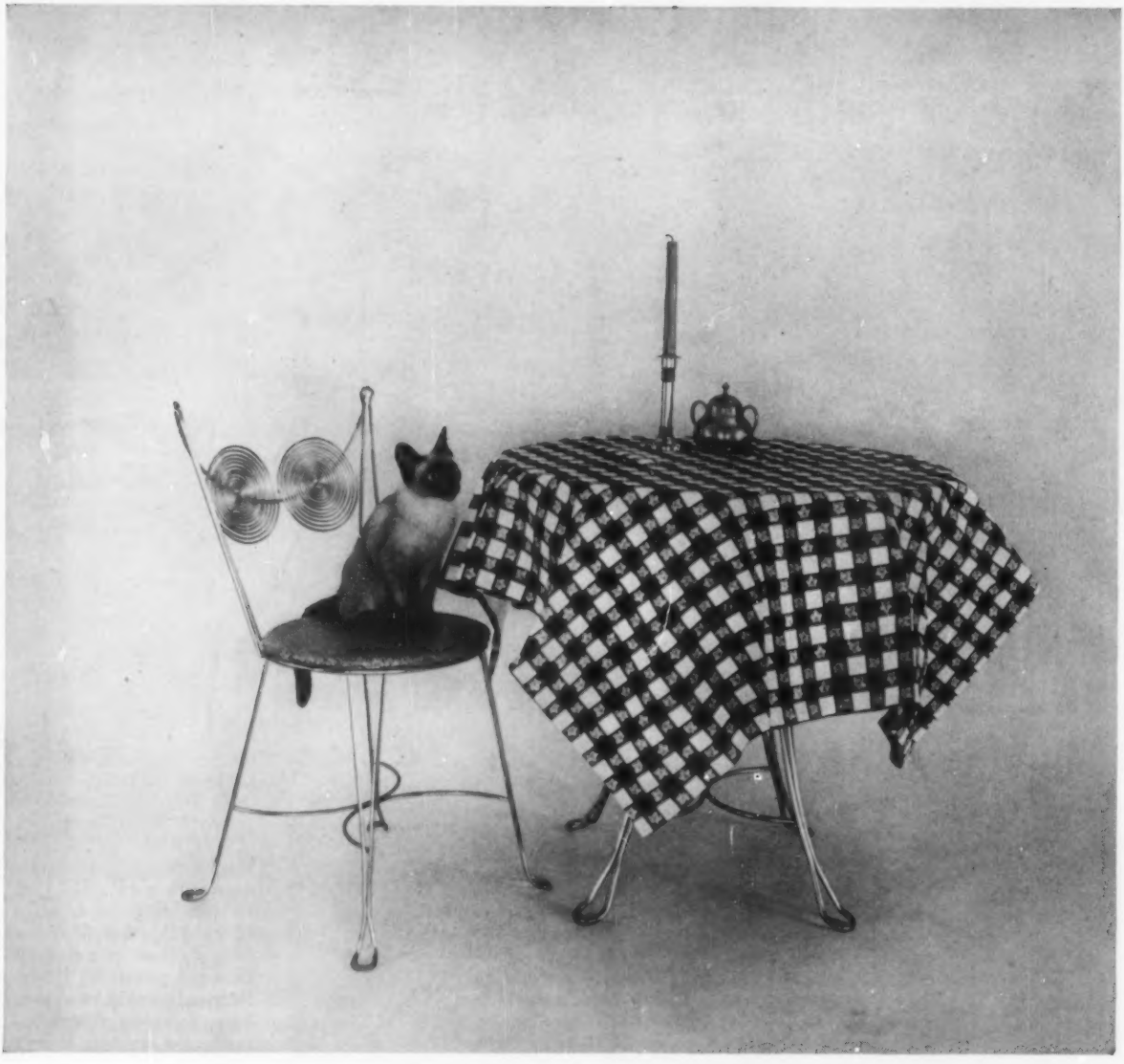

great expectations

YOU CAN COUNT on Argus to more than fulfill your expectations. Argus Mark stabilizers and Drapex plasticizers give unmatched performance. Argus products are the industry's standard.

Nothing, for instance, overcomes vinyl processing difficulties or insures high quality in calendered products like Argus Mark M. With a Mark M stabilizer system, the problem of roll plate-out is eliminated and excellent heat and light stability are gained. The end product – like the tablecloth shown above – has clear color, excellent printability, outstanding heat-sealing characteristics and resists sulphide staining.

Whatever your vinyl formulation problem, *Argus has the answer*—in line products or in our research laboratory. Write for technical bulletins and samples.

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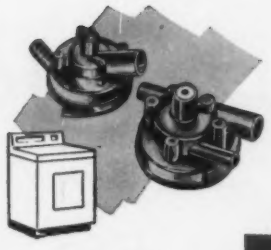
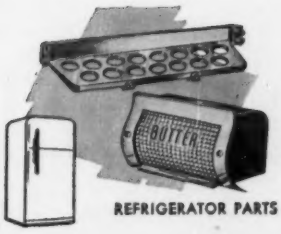
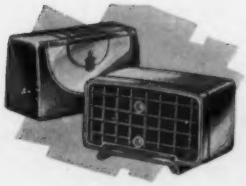


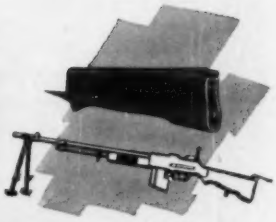
WASHER AND DRYER PARTS



REFRIGERATOR PARTS



RADIO CABINETS



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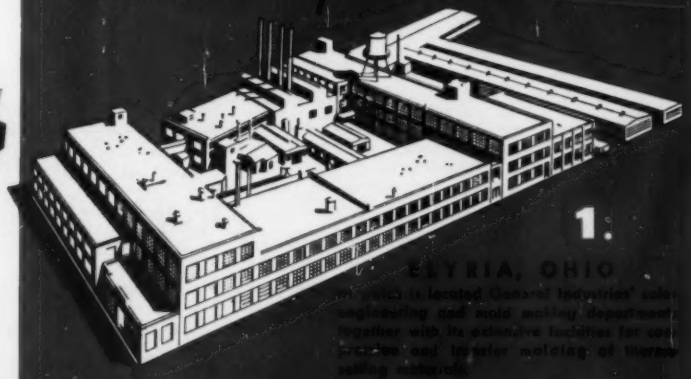


1.

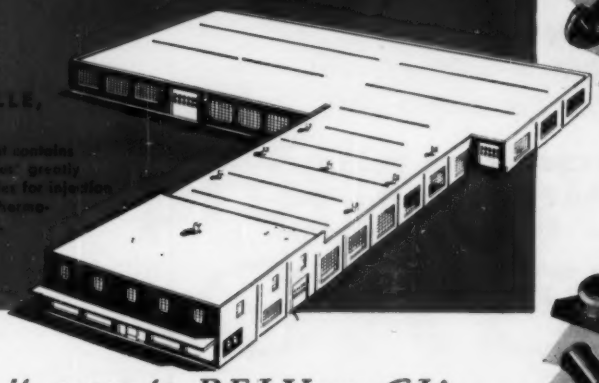
ELYRIA, OHIO

[illegible] is located [illegible] engineering and mold making departments, together with its extensive facilities for [illegible] molding of thermosetting materials.

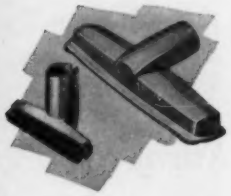
2.

MARYSVILLE, OHIO

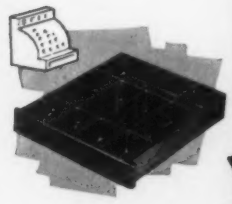
This modern plant contains [illegible] greatly expanded facilities for injection molding of all thermoplastic materials.



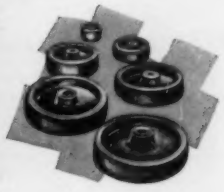
APPLIANCE HANDLES



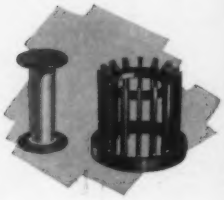
VACUUM CLEANER NOZZLES



CASH REGISTER DRAWERS

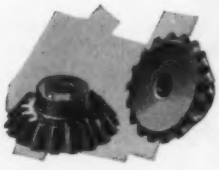


CASTERS



TEXTILE MACHINERY PARTS

TELEPHONE SETS



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- **COMPLETE ENGINEERING SERVICE**
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- **INJECTION MOLDING** 17 presses ranging up to 200 oz. capacity.
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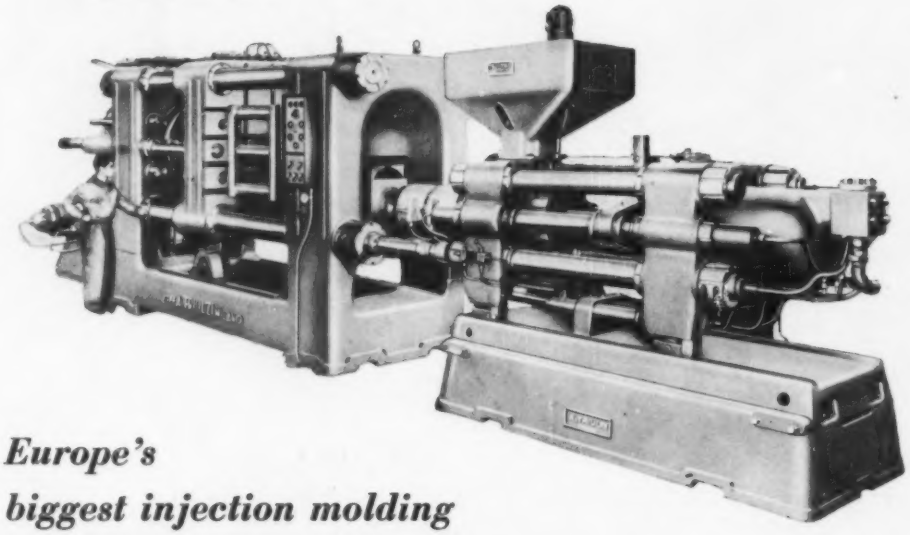
THE GENERAL INDUSTRIES CO.

PLASTIC DIVISION • ELYRIA, OHIO

Model PL 6/10



Europe's biggest injection molding machine with an injection capacity up to 350 ozs.

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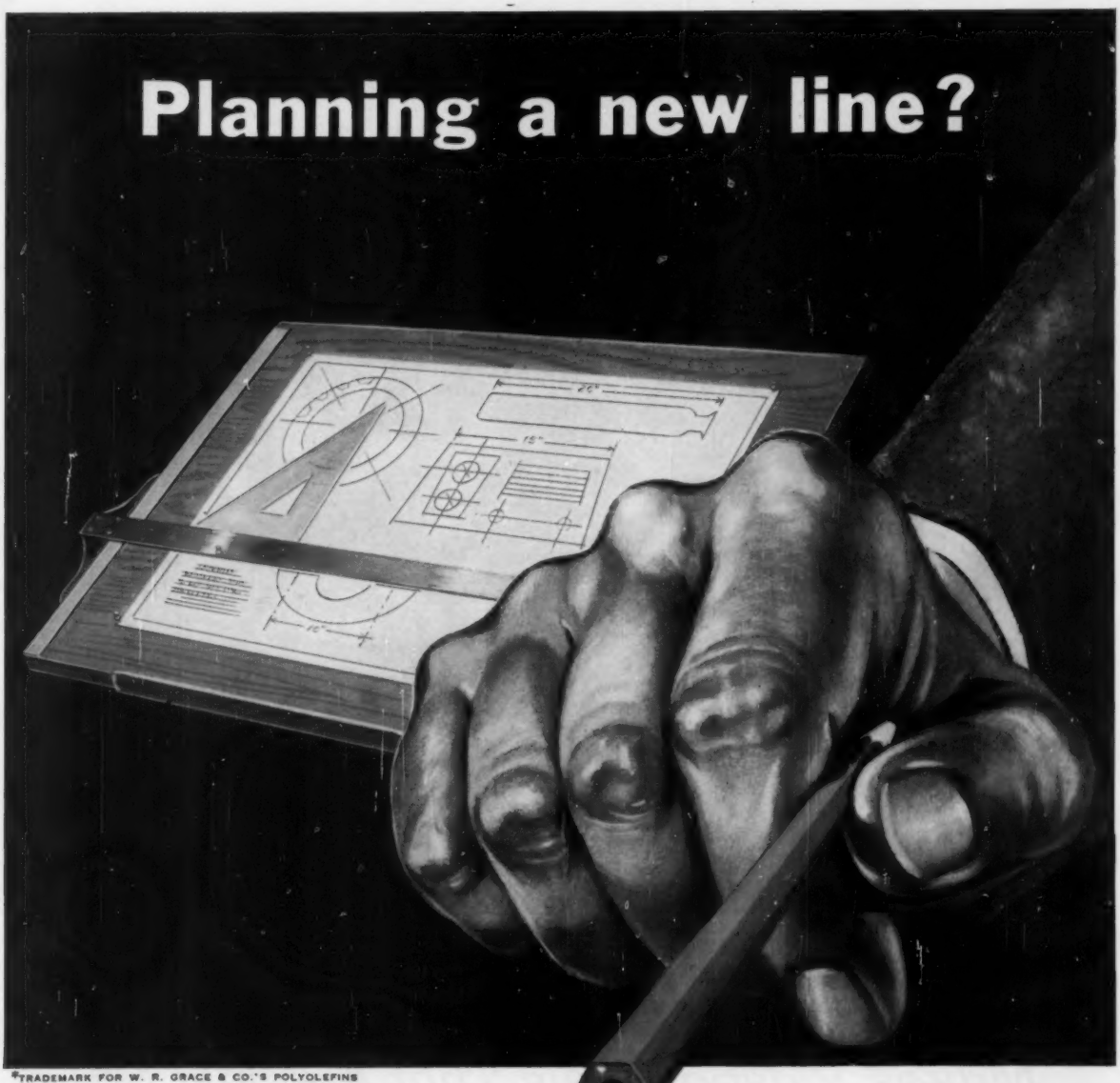

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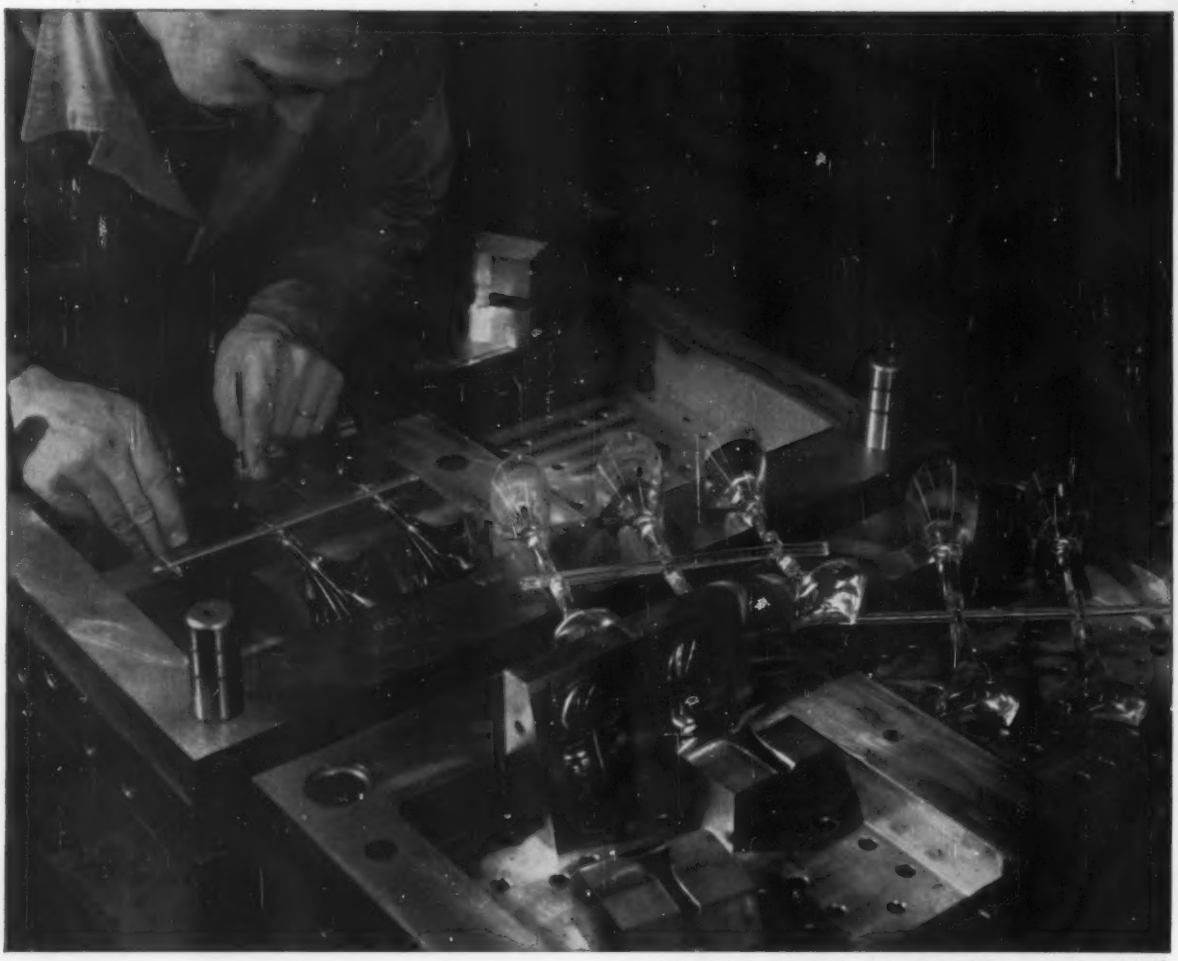

Lustre-Die injection mold made by Charles Zapf & Company, Evanston, Ill. Mold produces plastic heels for women's shoes at Missouri Wood Heel Co., St. Louis, Mo.

INJECTION MOLD OF LUSTRE-DIE

Makes Plastic Heels That Are Just So!

The problem wasn't easy. It called for tool steel that would (1) machine economically (2) have high mechanical properties (3) take an unusually high polish, and (4) have the stamina for volume production of slick, eye-stopper heels of butyrate and lucite, for women's shoes.

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Lustre-Die is outstanding tool steel for producing plastic parts because its properties enable it to take an unbelievably bright, mirror-like polish. Not only is Lustre-Die the proper analysis for working with plastics—we further enhance it by alloy fortification. The grade is heat-treated by oil quenching and tempering to build up its best properties, and is furnished ready for easy machining and polishing, all set to go.

Lustre-Die is electric-furnace steel, carefully inspected to insure the best degree of cleanliness. It is free from injurious porosity or surface pitting. And as for inclusion-causing additions, there's not a thing to be concerned about.

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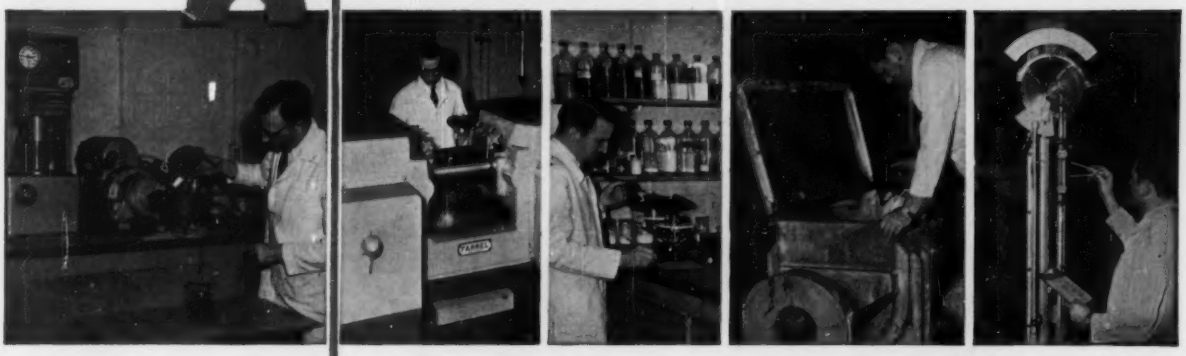

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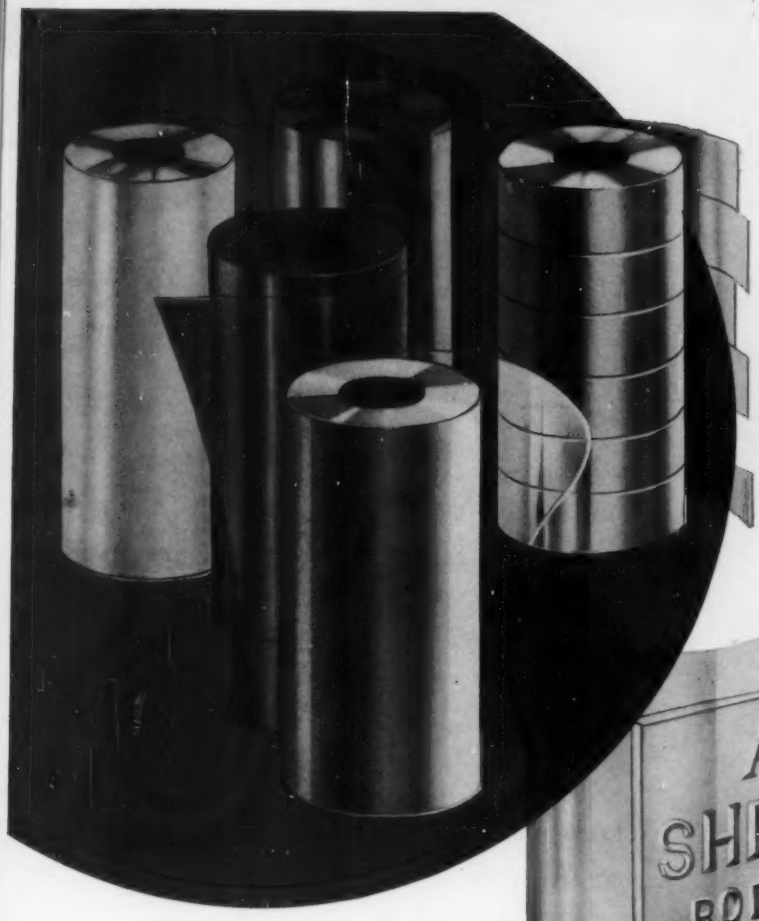

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WANTED: A plastic material to withstand direct contact with burning rocket-propellants

PROBLEM:

To fabricate reliable high strength, heat resistant turbine wheels to operate in contact with burning aircraft propellants without failure. High strength and resistance to temperatures from 1000° to 5000°F for short periods of time are required.

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1. *Excellent resistance to heat and flame*
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For further information, please write for technical bulletins

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TECHNICAL BULLETIN

CLAREMONT RESEARCH DIVISION

date: SEPTEMBER 1, 1957

subject:

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PRINTS BY HARTFORD TEXTILE CORP.

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For Calendering—Plastisol—Extrusion

Claremont's system of color calibration, a proven production time saver, enables vinyl calenderers to run as many as eighteen different colors per day without down time. Color range of Claremont dispersions is spectrum wide, includes non-tarnishing metallics also. The data in our Technical Bulletins Nos. 175 and 140 are practical and valuable to vinyl fabricators. Ask for your free copy.

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Claremont is an information and service center on plastic coloring and printing problems.

Our engineering suggestion and advice are always yours for the asking.

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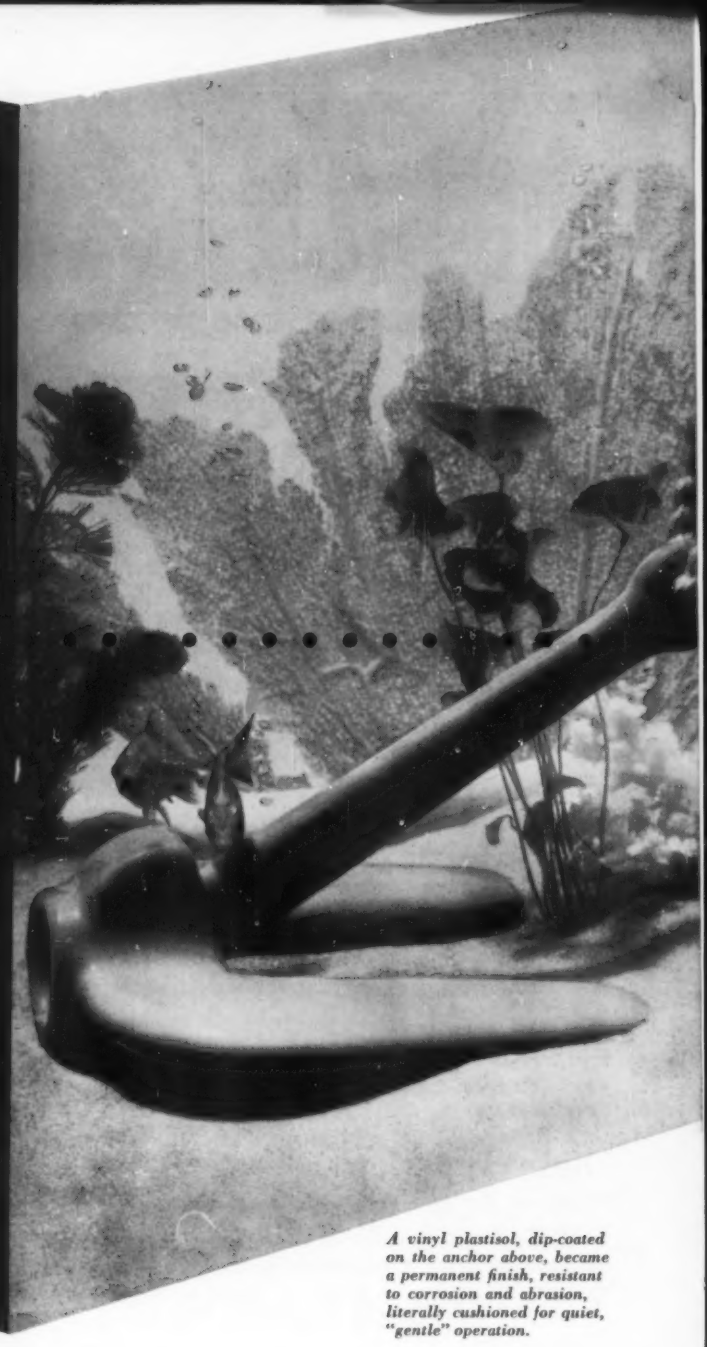
The broad Monsanto series of Vinyl resins and compounds



A vinyl plastisol, dip-coated on the anchor above, became a permanent finish, resistant to corrosion and abrasion, literally cushioned for quiet, "gentle" operation.

From a specially developed Monsanto vinyl paste resin, *Opalon 410*, come the finest vinyl plastisols. And from these colloidal dispersions of vinyl resin in plasticizers, come permanent and resilient finishes for metals, coated fabrics and paper for quality luggage, flooring and upholstery . . . slush-molded rain boots and dolls' heads . . . cast packaging films . . . foams for insulation and sound-proofing . . . caulking compounds and sealants.

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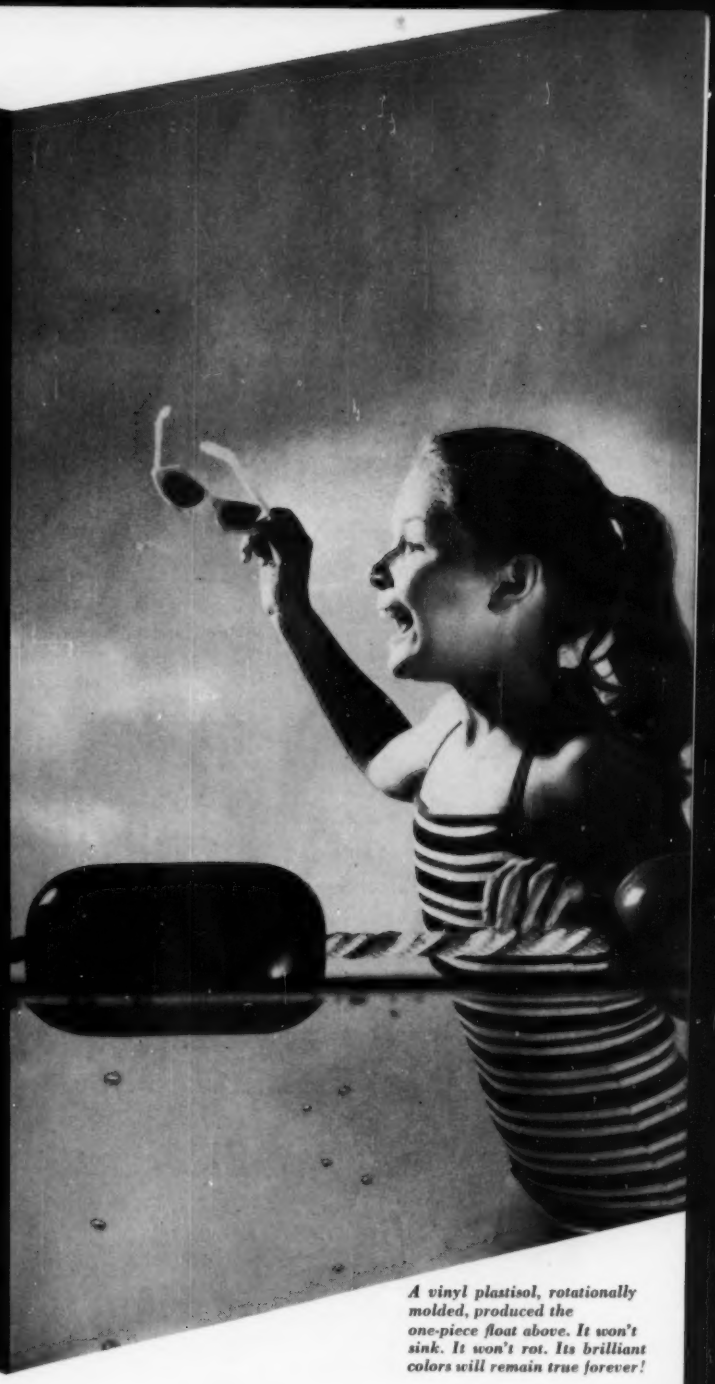
If Vinyl figures in your plans, draw on Monsanto experience, research, technical assistance and productive capacity. Write today for technical literature on Opalon vinyl resins and compounds. Monsanto Chemical Company, Plastics Division, Springfield 2, Mass.

Vinyl Plastisols

the new, low-cost source for fast improvement



A vinyl plastisol, rotationally molded, produced the one-piece float above. It won't sink. It won't rot. Its brilliant colors will remain true forever!

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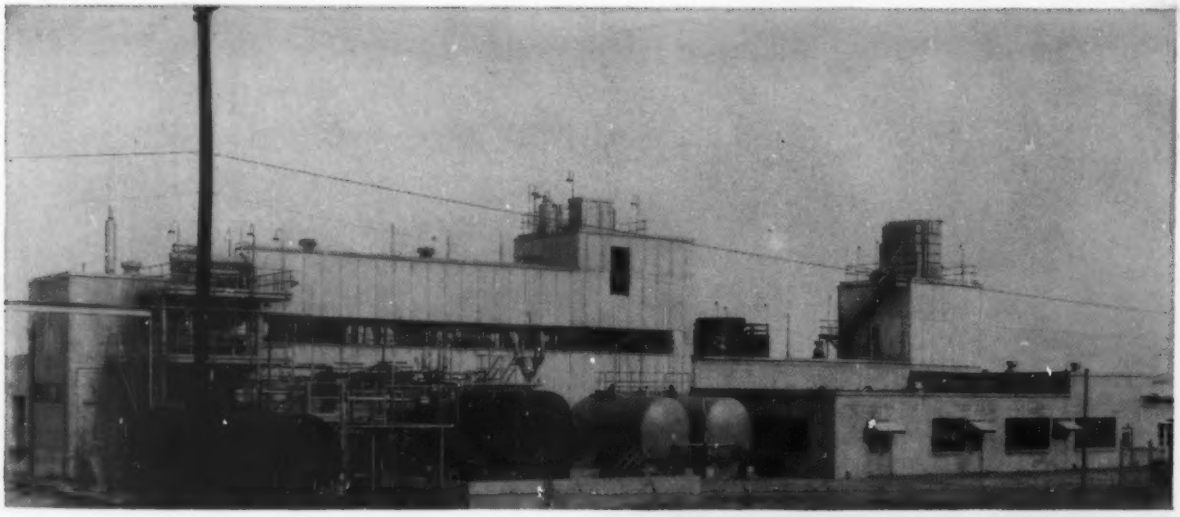

Polyvinyl chloride plant, designed and built for the Insular Chemical Corporation at Hicksville, New York, owned and operated jointly by Ross & Roberts Inc. and Rubber Corporation of America.

Heart of the process consists of reactors equipped with instrumentation for precise control of the process.

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The idea: improve production of vinyl film and sheeting by integrating a polyvinyl chloride resin plant into the operation.

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Blaw-Knox's 89th Resins and Plastics Facility

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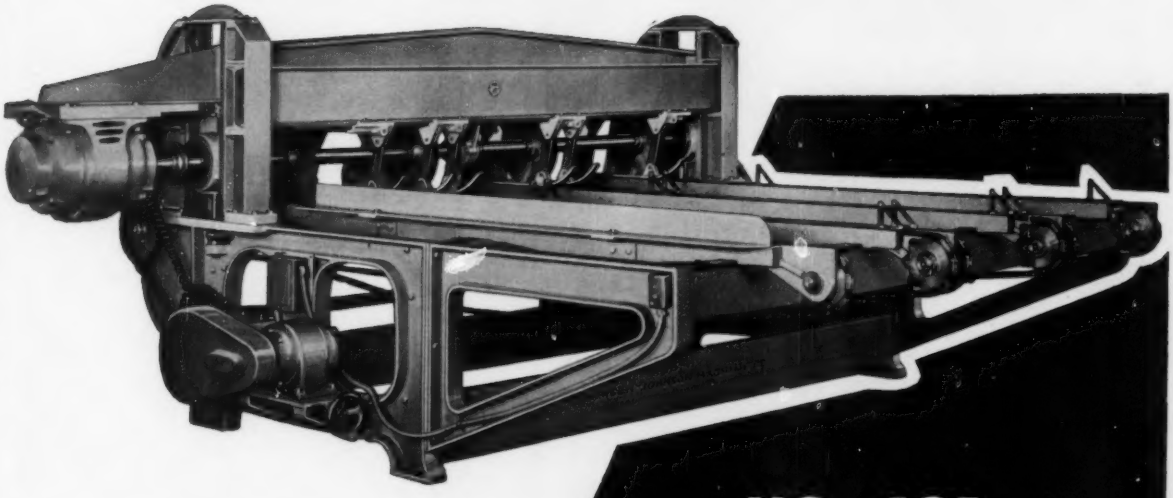
in just one fast operation!



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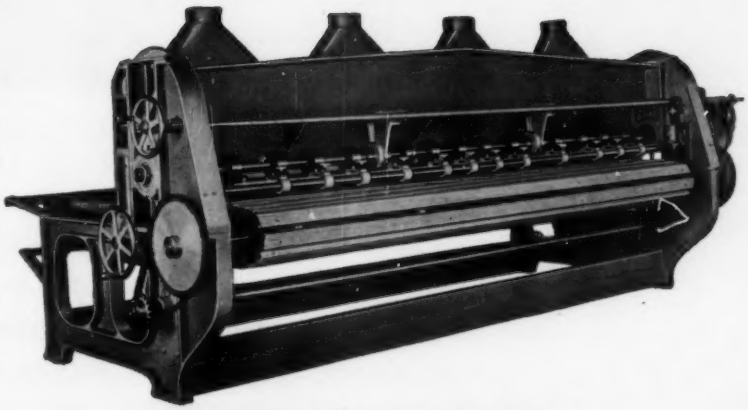
Let our engineers work with you to develop a machine installation that will solve your problem in the most efficient manner.



Rear View of 144x48 Slat Bed Machine

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Vinyl Stearate-vinyl acetate copolymers have improved water resistance and form tough, very flexible films – especially suitable for use in paints, adhesives, and textile finishes.

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. . . and Vinyl Stearate copolymers won't bleed, can't wash out . . . because the reaction is irreversible.

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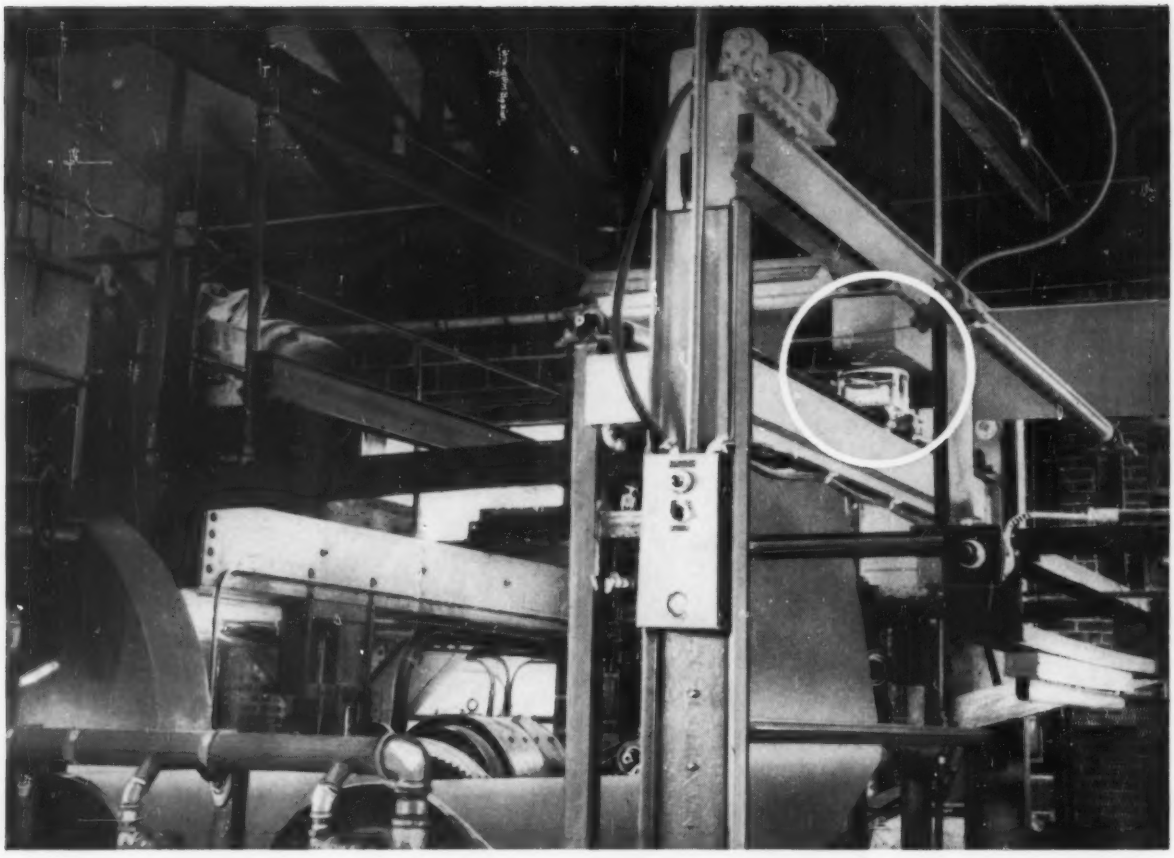

Curtiss-Wright Coating Control System

Operator adjusts controller to proper specification for each order.

Insures "On Spec" Production for Federal Industries

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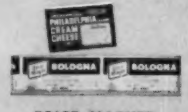

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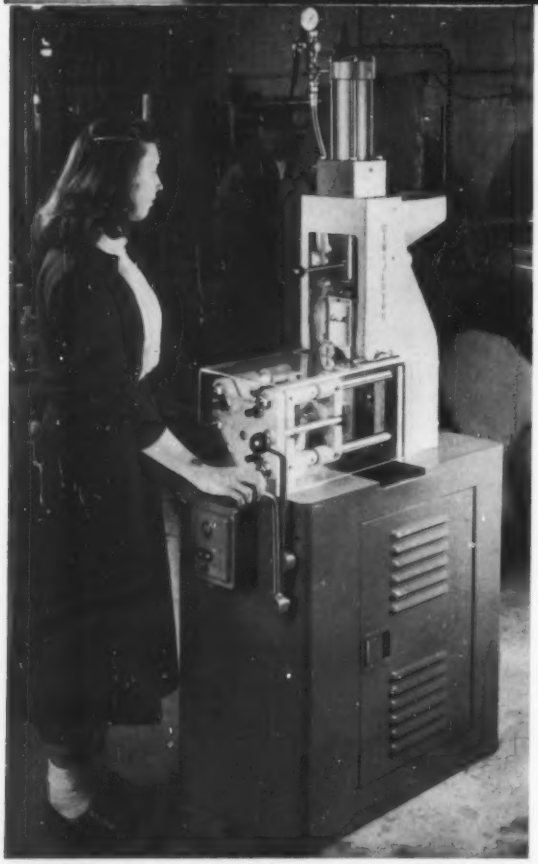

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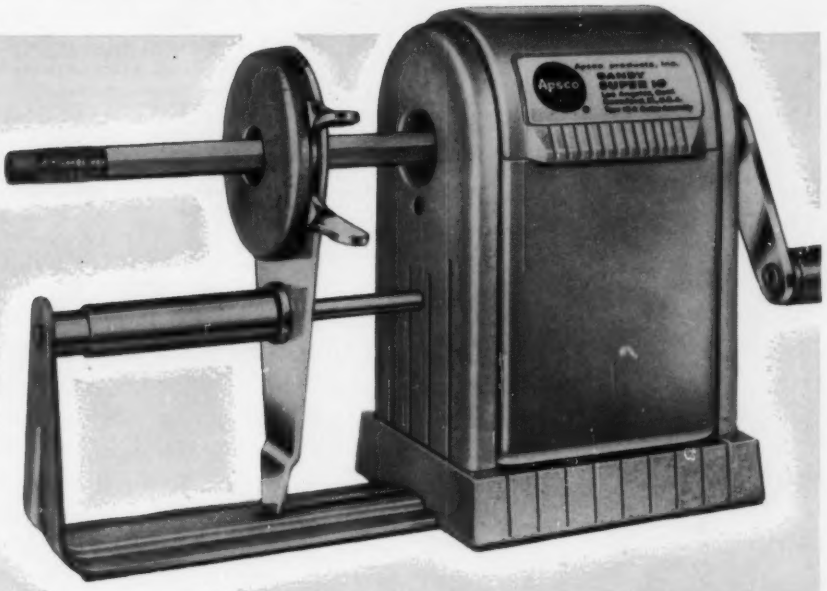

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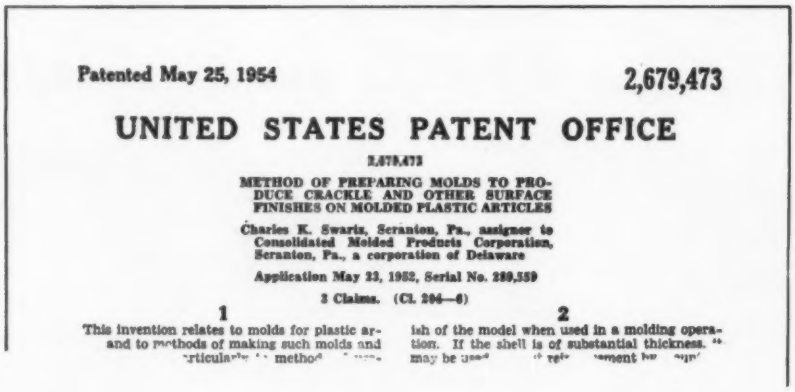

Patented May 25, 1954 2,679,473

UNITED STATES PATENT OFFICE

2,679,473

METHOD OF PREPARING MOLDS TO PRODUCE CRACKLE AND OTHER SURFACE FINISHES ON MOLDED PLASTIC ARTICLES

Charles K. Swartz, Scranton, Pa., assignor to Consolidated Molded Products Corporation, Scranton, Pa., a corporation of Delaware

Application May 23, 1952, Serial No. 289,559

3 Claims. (Cl. 204—6)

1

This invention relates to molds for plastic ar- and to methods of making such molds and articula[illegible] method[illegible]

2

ish of the model when used in a molding operation. If the shell is of substantial thickness, [illegible] may be used [illegible] reinforcement [illegible]

Now your machine housings in plastics can have "Crackle" and other beautiful finishes to match your metal components. Consolidated's distinctive process adds beauty and individuality to cabinets for typewriters, business machines and electronic equipment. As with all other Consolidated patents, this process is available free to our customers. We'll be glad to show you how these unusual textures by Consolidated can increase your sales.

There are many good, reliable molders of plastics in the field today. We at Consolidated pride ourselves on being included among them. We have always offered our customers certain "extras"—ingenious mold design, new processing techniques, and tested methods of quality and cost control.

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Another new development using

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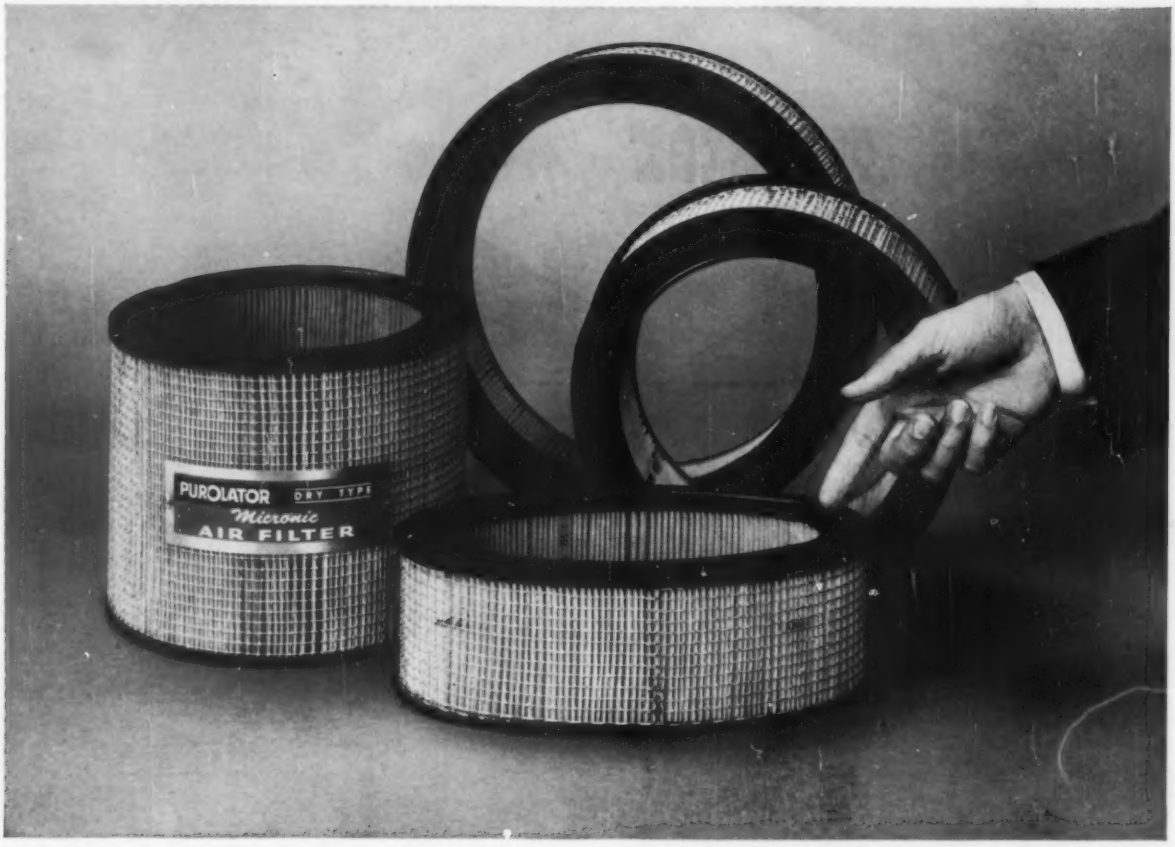

Dry type Micronic air filters are made by Purolator Products, Inc., Rahway, N. J. in a variety of shapes to meet automotive requirements. End rings made from Geon supplied by B.F.Goodrich Chemical Company stay strong and flexible despite severe service.

Geon materials simplify air filter design

THESE dry-type Micronic automotive air filters were formerly made by assembling the filter element with metal end rings. This required a cementing operation, and a gasket was needed for sealing.

Now the end rings are formed by simply dipping the filter element into a mold containing a plastisol based on a Geon polyvinyl material. This eliminates the metal fastening operation, and since the plastic is moderately flexible, no gasket is required. In addition, with this design the manufacturer finds it more economical to tool up for the many sizes and shapes of filters needed in different cars.

Geon polyvinyl materials offer outstanding properties—resistance to water, oil, most chemicals, to wear and abrasion. And they are easily formed by molding, extrusion, calendering, casting, etc. For ideas on using Geon to advantage in your products, write Dept. FQ-9, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

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Don't miss . . .

There is foam in your future, no matter what your business! The economics of plastics foams and their efficient application have been altered through technical advances to the point where they are invading fields long dominated by non-plastics materials. This is the first of two articles on the subject and deals with the flexible foams—the urethanes and the vinyls—in competition with rubber and with each other. If you are in the fields of clothing, furniture, automobiles, industrial and commercial seating, transportation, novelties, this article merits your study.
See "Flexible foams," p. 115.

Going to use rigid polyethylene? Here is the lowdown on how to design molds for this plastic and how to mold it. Because of its highly crystalline structure and low melt index, it requires higher cylinder and mold temperatures than the flexible polyethylenes. See "Injection molding rigid polyethylene," p. 149.

Modern decor demands foliage, and fresh foliage is expensive to buy and to maintain. Decorators of restaurants, hotels, offices, stores and exhibits are turning to vinyl and polyethylene plants which look most natural, may be cleaned with ease, and are practically indestructible. There is even available a do-it-yourself kit for making plastics plants. See "Permanent plants," p. 133.

The things you can do with a drill press in a plastics plant are many, and frequently this tool can do the same work as a much more costly machine. Milling, routing, shaping, grinding, even fusing can all be done with this simple power tool. See "Drill press is a versatile tool," p. 168.

Attention product designers! Now any shape of molded melamine item can be integrally decorated in the molding process. Decorative foil or overlay method, formerly used only for flat and simple curved surfaces such as dinnerware, is now adapted to tall shapes with compound curves. First example is "The Schlitztap," p. 122.

Better wearing qualities and improved dimensional stability can be obtained in nylon parts by making them from pressed and sintered nylon powders with a wide variety of fillers. For design and performance data and processing information read "Sintered nylon," p. 157.

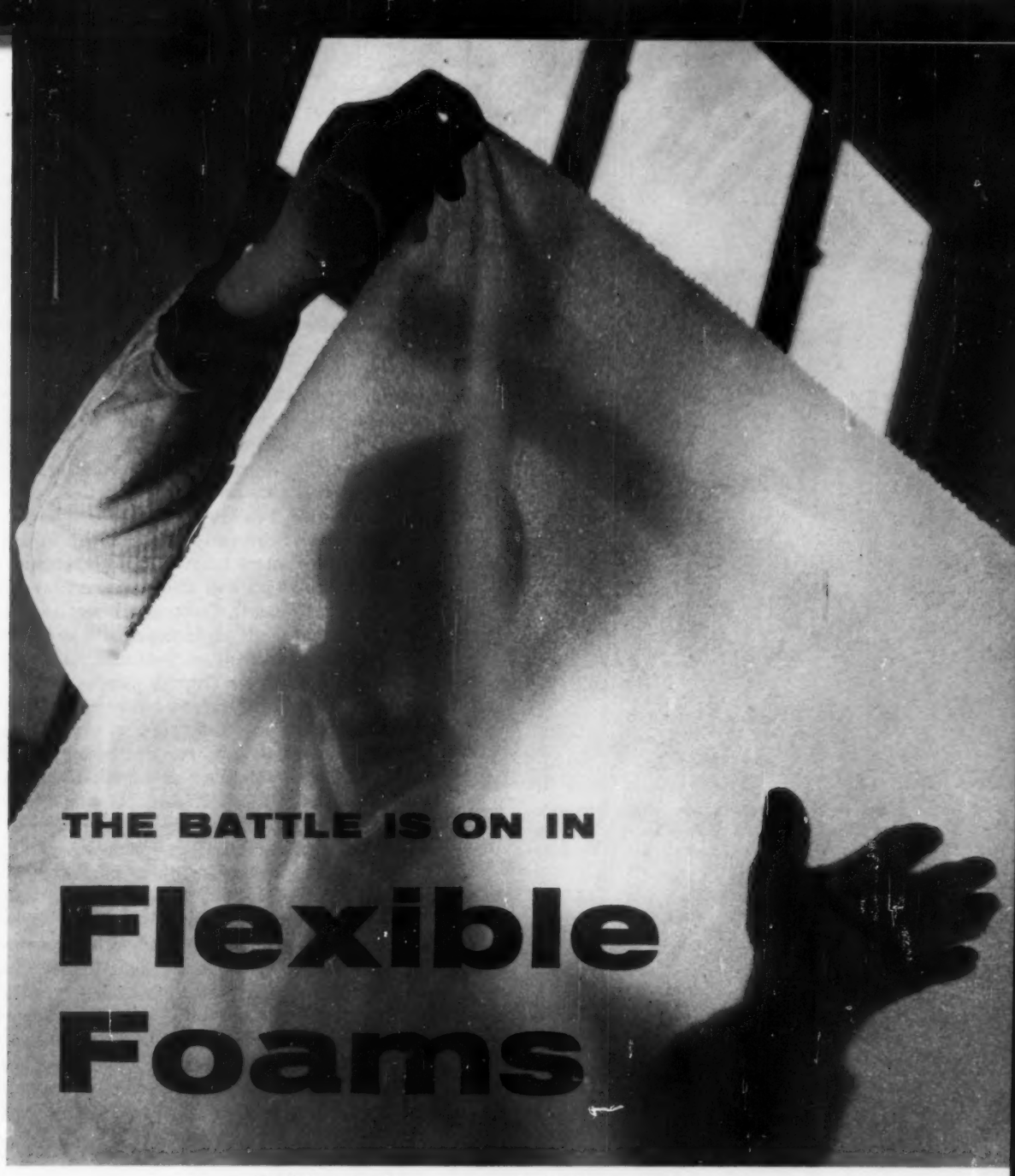
For architects, sign makers, and builders of theaters, churches, offices and plants it is now no longer necessary to have special designs and molds or forming dies made for the production of attractive plastics sign letters. A number of companies, having invested in molds and dies, now stock these letters in ¼ in. to 4 ft. heights and in a wide variety of sizes, styles, and colors. See "Alphabets in stock," p. 140.

A new range of plastics is made possible by the use of radiation as a catalyst in synthesizing copolymers. This article opens up a gate in the technology and throws light on the polymer path ahead. See "Role of radiation in graft and block polymer synthesis," p. 171.

New tools for many uses are the liquid and paste epoxy compounds. To date they have been used in patching, cementing, potting, and in tool production. For a quick review of the types now offered and their applications see "Which epoxy compound?", p. 128.

Do you use plasticizers or materials containing plasticizers? Once a year MODERN PLASTICS presents a tabular listing of production and sales of the different kinds of plasticizers and an analysis of their usage. See "How much plasticizers for vinyl?", p. 222.

Watch for... A survey of World Trade in Plastics will be our October lead feature. Specially prepared for MODERN PLASTICS, it will include maps showing locations of polymerization plants in all countries, along with tables listing the polymer procedures.



THE BATTLE IS ON IN

Flexible Foams

So thin it is almost transparent, this 5/64-in. sheet of urethane foam retains ample tensile strength to be stitched into place as garment lining. (Photo, Mobay)

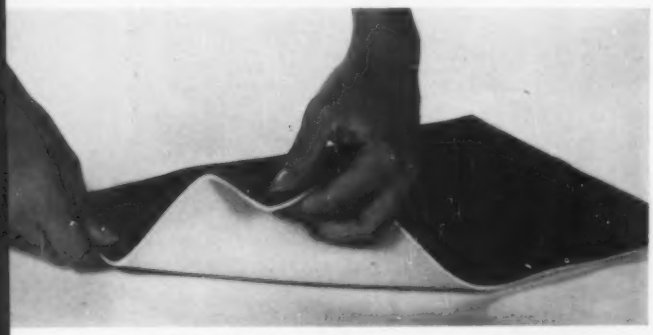
A new industry on the American scene—foamed plastics—has been through a difficult birth struggle, and is now blooming into adolescence, ready to battle for markets with an already well established rubber foam.

The words "foamed plastics" must be considered in a completely new context—as a generic term for a basic group of materials which before very long will be as familiar as steel or glass or paper.

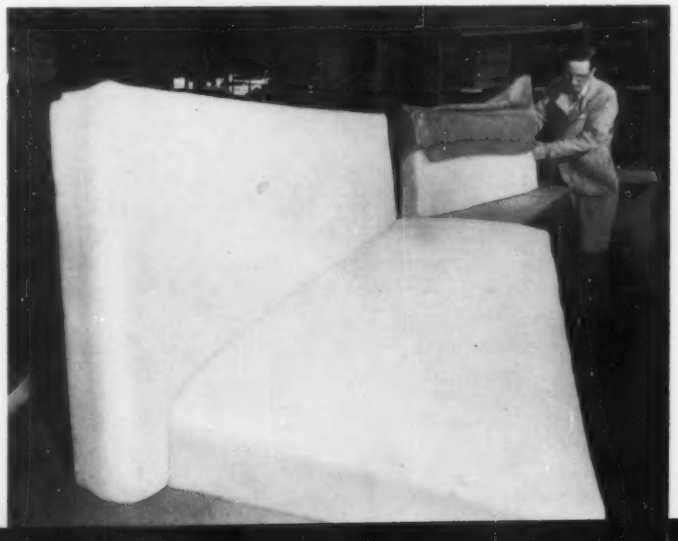
People who can't pronounce polyurethane today will next year be wearing it, sitting on it, and riding on it. In a few years they may also be living with walls and ceilings insulated by it or by some other foamed plastic.

Though any plastic can be foamed in the lab, only three loom large on the commercial horizon at this time: urethane, vinyl, and styrene. Four others—polyethylene, phenolics, cellulose acetate, and the silicones—also offer unique

Strength of urethane foam makes it possible to fabricate complex shapes for a variety of industrial end uses. (Photos, Mobay Chemical)



Heat-sealed to vinyl film, sheet of urethane foam provides padding behind scuff-resistant surface. Supplied in rolls, material is used for covering walls and bar fronts, and in similar applications



One-piece furniture cushions of urethane foam are simply slipped into covering

properties of their own and should find niches for themselves in the new industry.

Coming strongly into the market battle is flexible urethane foam. The growth curve for this material in the next four years promises to rival the eye-popping phenomenon of the chemical reaction itself, where a charge of material expands to 30 times its original liquid volume in one minute to form a cured, dry thermoset foam.

The biggest plastics competitor to foamed urethane in its flexible form is foamed vinyl, which is admittedly easier to mold and to heat seal, since it is a thermoplastic. The three-way battle between flexible urethane, vinyl, and rubber foams is currently being fought on the foggy front of material density. Urethane lends itself to the production of ultra-light densities—as little as 2 lb./cu. ft. Commercial densities of vinyl foam have not yet approached this point. Rubber foam currently is produced, uncored, in 6- or 7-lb. densities. In any discussion concerning this "battle," references to cushioning and the claims and counter-claims of effective densities in cushioning are most polemic and are invariably related to raw material costs per cubic foot of finished foam. Raw materials that go into rubber foam are the least expensive, vinyl next, and urethane highest.

Vinyl and urethane—either polyester or polyether type—are the only important flexible foams today. Rigid foam, though it offers equally great potential, is further away from large-scale commercial use. Rigid foams will be dealt with in a subsequent article.

The cushioning market

Right now flexible urethane foam is stepping into the battlefield against foamed rubber and vinyl after two or three years of preliminary

maneuvers. These materials will fight it out, application for application, and penny for penny. The stakes are two of the largest segments of the U. S. cushioning market—automotive seating and furniture. So far, of course, there has been no real contest. Rubber foam consumption has been running in the neighborhood of 250 million lb. a year, while flexible urethane foam, in comparison, was an estimated 8 to 10 million lb. in 1956, a figure which is seriously challenged in vinyl quarters. The debate stems partly from the differential between urethane produced and that in use; the material has been undergoing such intensive development that large quantities—perhaps 30% of production—have been necessary to fill the needs of experimental and developmental work.

For the current year, educated estimates on urethane foam production run between 25 and 35 million lb., though these figures could be low or high by 20%, the experts admit. Production of vinyl foam in 1956 is estimated at about 3 million pounds. No 1957 estimate is available.

By 1959 or 1960, Mobay Chemical Co. expects annual sales of flexible urethane foam to reach 100 to 125 million pounds. Du Pont is a little more conservative in its sales estimates. William H. Ayscue, sales manager of isocyanates (which are reacted with polyester or polyether to produce foam) for Du Pont, believes the 100 million pound level won't be achieved until 1960 or 1961.

Mobay is one of the chief proponents of urethane and a basic producer of isocyanates. In addition to supplying raw materials, Mobay sells production machinery and licenses an operational process on a royalty basis.

Patent situation

Du Pont has the strongest patent position on the chemical reaction that produces the foam. That company has recently announced a policy of royalty-free licenses under certain of its patents. The company has licensed roughly 100 firms, about one-fourth of which are in actual production. With a different approach to the field, Mobay has 14 licensees, all in production.

The third U. S. isocyanate producer is National Aniline Div. of Allied Chemical & Dye Corp. which brought a big new plant on stream in Moundsville, Va., last December.

The urethane industry badly needs the handsome sales figures projected above. From the chemical suppliers on down, it is far from op-

Urethane foam strips, cut from slab stock, are used in place of cotton or sisal in arms, backs, and sides of chairs. (Photo, Du Pont)

Furniture construction can be simplified, because foam is strong enough to be hog-ringed directly to springs. (Photo, Mobay)

Assembly is speeded; foam permits use of staplers, unskilled labor. (Photo, Du Pont)

Cold-weather jacket is light yet warm because of its interlining of urethane foam. (See also photo on p. 115). Cutaway sketch above shows how layer of foam is sandwiched between coat fabric and garment lining. (Photos, Du Pont)

Automotive applications of urethane foam include instrument panel covers for 1957 Ford (at upper left in photo below) and Thunderbird (at lower left) and prototypes of sun visors and arm rests. Model at right (below) is twisting one of the Ford dash covers to demonstrate its construction. (Photo, Du Pont)

erating in the black. The principals in the field expected volume "break-through" much earlier than it will come. One top executive described the situation to date as "disappointing but not disastrous." This sounds like strange language from a representative of an industry about to make a jet-assisted take off; it reflects the fact that development costs have not been light. This supplier, in the early days, thought it had a miracle in its test tubes. It did, but ten years were required to reach big volume.

The development of recent origin which puts urethane foam in real competition with foamed rubber is the switch from polyester to polyether for reaction with isocyanate. Wyandotte Chemical Co., a basic producer of the polyether glycols used to produce polyether, has done considerable development work on the chemical. Dow polyether at 25 to 26¢/lb. in carloads, compared with about 50¢ for polyester, pulls the price of urethane slab stock 25 to 30% under foam rubber for a given volume of ma-

Molded foam section of Chrysler rear seat provides thin but comfortable cushion over transmission "hump." Wire springs are molded into the urethane. (Photo, Du Pont)

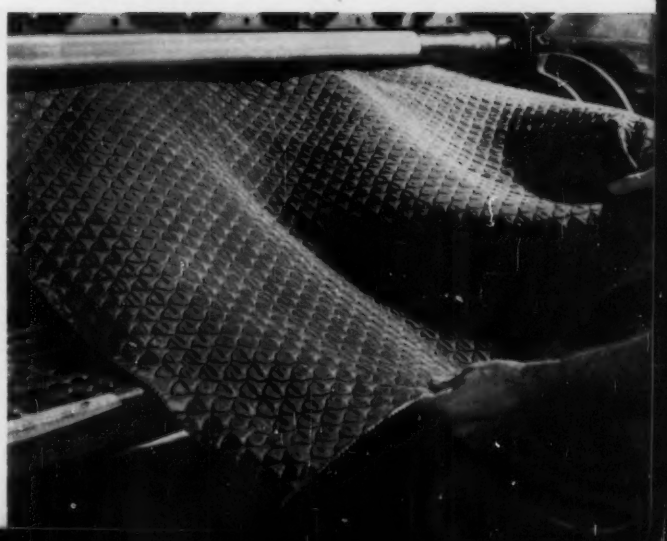
Array of applications of urethane foam in the home and for the wardrobe point up some of the "1001 uses" so frequently claimed for the material. Those shown include pillows, chair cushions, ironing board pads, rug underlays, paint rollers, toy bath sponges, shoulder pads, padded mattress covers, and clothes-hanger pads. (Photo, Du Pont)

Cockpit of motorboat is padded with urethane foam at strategic points for comfort, safety, and beauty. (Photo, Mobay)

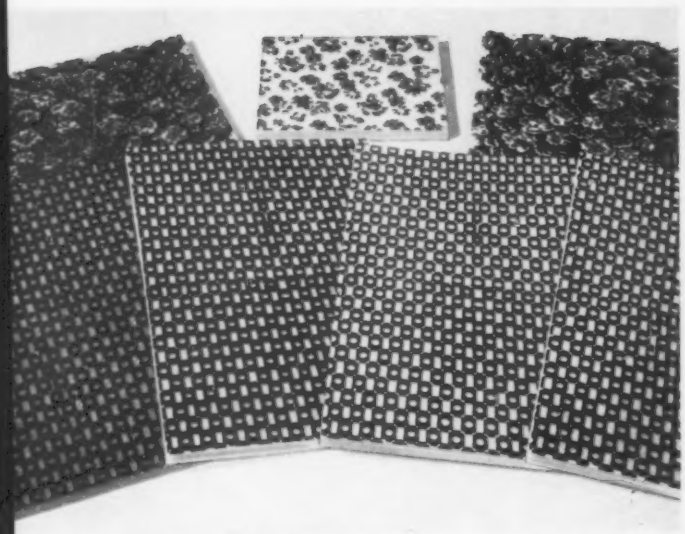
terial. In terms of finished cushions, the price is about 10% less, according to current estimates from the foam manufacturers.

At the same time, ether foam has a compression-deflection curve similar to foamed rubber, while the ester material has a "boardy" feel which resists compression initially and then sinks. Which material provides the best seat is a source of much argument, but since rubber foam has been the accepted material its properties have become the standard. People buy furniture by how it feels, and ester foam hasn't made much headway in the furniture showroom. In some phases of transportation seating, a springy foam can bounce a rider tiresomely, and ester foam has an advantage in this area. Much aircraft seating installed to date used ester foam.

Of course, urethane foam can hold its price position only because of its unique density advantage. Rubber foam of 6- to 7-lb./cu. ft. density is necessary to do the same cushioning job



Quilting of urethane foam and conventional fabric to obtain various effects can be accomplished on ordinary textile quilting equipment. (Photo, Mobay)



Surface interest on urethane foam is obtainable by silk-screening (top) as well as embossing and flocking. (Photo, Mobay)

that 2- or 3-lb. urethane will do. Vinyl, with its advantage of heat sealing, is in the middle. Foam rubber manufacturers have to provide twice as much poundage of material per application, compared with urethane.

Comparative prices

Some urethane foam experts feel that rubber producers, awake to the threat from the newer material, can "easily" reduce prices as much as 25% in the future. But by the time this happens, they conjecture, isocyanate, held up at the 95¢/lb. level by low volume, can come down to 75¢ and lead the ether foam price downward still further. Isocyanate makes up 30% by weight of the finished foam. One raw materials supplier said, in summary, "rubber foam can't go as low as we can without taking a sustained loss."

The big rubber companies have been put into a precarious position by urethane. Akron has been giving urethane foam the back of one hand while grabbing up licenses with the other. The foam presents aging problems, is hard to mold, and is an unproved material, they say. There is some truth in this, but it's also true that the rubber industry must protect its considerable investment in rubber foam equipment, and fight to hold a major market of the raw material for which it has set up globe-girdling supply lines.

The exception here is General Tire & Rubber Co., which sold out a modest investment in rubber foam two years ago and jumped into urethane with both feet. General could easily become the top urethane foam manufacturer; is also big in vinyl foam. Within a year or so, the other rubber companies will be ready to take major positions in the field. Goodyear, U. S. Rubber, and B. F. Goodrich, (through its Sponge Products Div., also in vinyl foam) are all producing some urethane today and could expand rapidly with opening markets. Firestone has exhibited a lesser interest in the field, but has also protected itself with licenses.

Other rubber companies now in urethane are Dayton Rubber Co., Dayton, Ohio, and its af-

Change pad for retail outlets, made of vinyl foam heat sealed to vinyl film, is one of many products which use the material's heat-sealability. (Photos, Bakelite)

Furniture upholstered in Bolta-Quilt, a combination cushioning and covering material which consists of a sandwich of vinyl foam between a vinyl skin and a fabric backing

filiate, American Latex Products Corp., Hawthorne, Calif.; Dryden Rubber Div. of Sheller Mfg. Corp., Chicago, Ill. and American Rubber Products Co., La Porte, Ind.

In addition these firms are important in the field: Curtiss-Wright Corp., New York, N.Y.; Nopco Chemical Co., Harrison, N.J.; Armour & Co., Chicago, Ill.; General Motors' Inland Mfg. Div., Dayton, Ohio; Wm. T. Burnett & Co., Inc., Baltimore, Md.; Hewitt-Robins, Inc., Franklin, N. J.; F. Burkart Mfg. Co. Div. of Textron American Inc., St. Louis, Mo.; and Hudson Cush-N-Foam Corp., Yonkers, N. Y. Nopco Chemical recently opened a 3 million lb. foam plant in Arlington, N. J.

To core or not to core

Two of the biggest questions facing urethane foam manufacturers today are 1) to core or not to core, and 2) to mold or not to mold. Ester cushioning needs coring to get enough resilience. With ether foam, the coring is not essential, but it does save material and may offer some comfort advantages. As regards molding, the great majority of rubber cushions are individually molded, which prompts some urethane men to believe that the newer material will follow the same path.

Technology has lagged in this area, but is fast catching up. Both Mobay and Du Pont are molding urethane foam cushions to point the way for their customers. Du Pont has set up an elaborate mass-production molding line at its Chestnut Run sales service laboratory. At least one foam manufacturer, E. R. Carpenter Co., Richmond, Va., is setting up a production line for molded cushions, and many other manufacturers are feverishly at work with experimental setups.

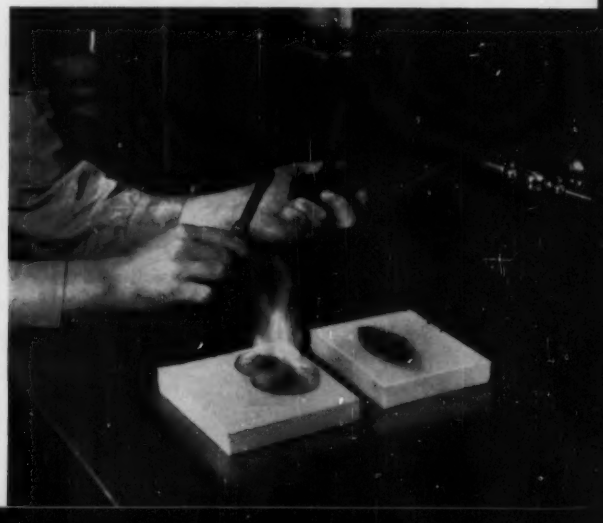
Once a line for molded cushions has been installed, coring can be done at will by changing the top half of the mold. The molding process saves considerable cutting and shaping of a cushion. Whether it will become the most important production method for urethane cushions—as in rubber foam, where about 80% of the cushioning is molded—is a debatable point at this time. It is significant that one of the automobile manufacturers will be using seat cushioning cut from urethane slab stock in the near future.

Outside of the main seat cushion, there's a great deal of room for urethane in furniture. Urethane is different from rubber, not merely a substitute, and offers specific advantages. Its high tensile strength allows it to be cut, stapled, or sewn.

One manufacturer of living-room furniture, Crest, Inc., Ashville, N.C., is using urethane (polyester type) exclusively in place of the standard cotton felt or sisal in arms, backings, and sides. Though the material is perhaps 10 times the price of cotton felt, it offers labor savings which economically justify its use. Crest buys urethane stock from a nearby Dayton rubber plant, cuts it and staples it with pneumatic guns to the wooden chair frame. Average density of the sheet material is 2.8 lb./cu. feet. In the seat and back cushions, Crest uses foam rubber. The combination yields a well-constructed, comfortable chair which the company can advertise as "all foam"; (*To page* 238)

Auto seat reupholstered in Bolta-Quilt, made by Bolta Products, adds comfort and contributes new-car appearance to older car. (Photos, Bakelite)

Flame test shows superiority of self-extinguishing vinyl foam over rubber foam sample. Latter burns after flame is removed. All plastics foams are self-extinguishing



Integral multi-color decoration of thermosetting parts having compound curved surfaces, accomplished as part of the molding process, opens up a host of design possibilities

The

Extending high above bar at Toffenetti's in Chicago, molded decorated melamine tap handles promote immediate brand name identification. (Photo, Chicago Molded)

For the first time, classic multi-color decorated porcelain in a shape involving compound curves has been successfully simulated in virtually unbreakable molded melamine. This accomplishment, the result of two years of development by Chicago Molded Products Corp., Chicago, Ill., in cooperation with Commercial Decal, Inc., Mt. Vernon, N.Y., opens to designers a whole new field of service and to compression molders a big new market with excellent potential.

The product in point is the new "Schlitztap" handle for draught beer installations, introduced by Jos. Schlitz Brewing Co.

From the production standpoint, the new Schlitztap points up the possibility of molding numerous other types of melamine or urea items with integral decoration. Using the process described, such products as clock cases, small radio cabinets, auto steering-wheel medallions, door knobs, organ stop keys, electric shaver housings, decorative re-use packages, and bottle closures may be successfully produced.

Specially prepared overlays

Application of the five-color scenes to the melamine handles is made possible through the use of specially prepared melamine overlays or foils which are fused into the plastic parts as part of the molding process. The foils are made by Commercial Decal, Inc., under sub-

SCHLITZTAP

license from Einson-Freeman Co., Inc., holders of the basic patents on the process.

Each decorated handle section requires two of these overlays, slightly different in design—one on the front and one on the back. Although during the past couple of years a number of manufacturers of melamine tableware have introduced dinner plates and related pieces decorated by the same basic method, the new Schlitztap handle marks the first application of this technique to a compound-curved surface and the first production use of the melamine foil overlays outside the dinnerware field.

The new Schlitztap unit includes three molded melamine components—the handle section itself (which carries the decoration), a color band, and a collar. The color band is molded in a soft green; the pattern section and

Disassembled view of Schlitztap. Three molded melamine parts are in center, threaded aluminum shaft is at left, anodized aluminum crown and shank at right. Last two components are threaded internally to screw onto shaft and beer tap control lever

New draught beer tap handle introduced by Schlitz marks first application of foil overlay decorating technique to products having compound curvature. Handle incorporates two Bavarian village scenes printed in five colors. (Photo, Jos. Schlitz Brewing Co.; color plates, Commercial Decal, Inc.)

Several outstanding tap handles were imported from abroad for study before arriving at final design for Schlitztap. Handle in center of photo, containing a hand-crafted porcelain middle section, inspired the design treatment ultimately chosen. (Photo, Jos. Schlitz)

The beer tap handle described here is the first industrial application of a method of producing permanently decorated melamine parts; the method has been in use for several years in the melamine tableware field and has brought to that industry new respect, appreciation, and sales.

Development work now being concluded will make it possible for the method to be used in decorating while molding both urea and melamine in very deep draws and contours.

collar are in pure white. The plastic parts, together with an anodized aluminum crown and shank, are assembled on a threaded aluminum rod to produce the complete handle.

The unit was conceived and designed by Jos. Schlitz Brewing Co., and production was turned over to Hammer Bros., Inc., a Chicago firm specializing in signs and advertising specialties. This company worked closely with the Schlitz Merchandising Dept. and with Chicago Molded Products Corp., to solve the numerous problems involved in producing the first thermosetting parts to be integrally decorated "in the round." Approximately two years elapsed between the time Schlitz officials approved the new decorated handle project and final working out of tooling and molding kinks.

When the Schlitz Merchandising Dept. gave the green light to development of the new handle, the intention was to go far beyond the identifying knobs currently used by a number of brewers for draught beer installations. Around 1950, Schlitz was first in the industry to introduce a molded plastic knob combining brand identification and unusual design treatment. This was an injection molded white acrylic tap handle carrying the Schlitz rhomboid logotype as a decorative metal insert. This knob, incidentally, will be continued in use, together with the new unit.

With the industry-wide decline in draught beer sales as a percentage of total volume and the continued emphasis on packaged beer merchandising, Schlitz projected the new decorated tap handle as a powerful brand reminder in taverns, clubs, and other outlets where draught beer is sold. Standing approximately 12 in. high, the plastic handle with its distinctive colors and surface design immediately suggests the Schlitz brand to the draught beer patron.

"Look for this tap of quality," states a cur-

First step in transfer molding integrally decorated section of handle: two preheated blocks of white melamine material are placed in pot, or loading well, at left of the single-cavity transfer mold. (Photos, Chicago Molded Products Corp.)

rent Schlitz ad. "Refresh at your tavern. Something new in many of the finest taverns these days . . . something that will remind you how good Schlitz on draught is. It's the colorful new Schlitztap, standing tall above the bar to tell you how proud your tavern keeper is to offer you Schlitz, the world's best seller. Look for this tap of quality when you want really fine refreshment. . . ."

Before working out the design of the new draught handle, Schlitz obtained from England and Europe representative models of a number of draught pumps having outstanding design. More than a dozen such handles were imported for preliminary study. Some of them were heavily insured museum pieces which were secured only after elaborate precautions had been taken to assure their safe return.

Some of these imported draught beer handles were made of wood and others of metal. Some included handcrafted ceramic inserts, which Schlitz decided was the overall design approach to be followed. Next, the Merchandising Dept. studied dozens of possible design adaptations by well known industrial designers before the final model was chosen. The decoration of the handle was developed by Phoebe Moore, prominent Chicago artist and designer.

In developing the final size and shape of the handle, Schlitz and Hammer worked with carved aluminum billets. The weight distribution and balance of the finished handle had to be closely controlled so it could be used on draught beer taps having a wide range of settings from relatively light to very firm. Because of the length of the handle, the bartender can apply extreme leverage to the tap with very little effort. During this development period, Schlitz draught beer specialists worked in representative taverns to study reactions to such a tap handle.

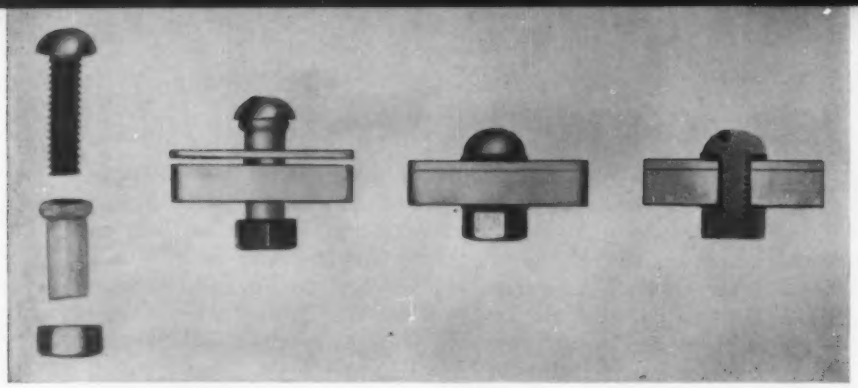
Conferences with the molder

Once the design of the new unit had been established, conferences were started with Chicago Molded's engineers covering the actual production of the finished handle. From the very first, Schlitz had intended the knob to be made of melamine, using the new decorating technique, and had posed that as a requirement to Hammer Bros. However, much experimentation remained to be done because of the problems inherent in fusing the sign into a compound curved surface.

In June 1956, the first undecorated "raw" shots were made by the molder. Then preliminary studies of decorating technique were made, using available foils designed for dinnerware. At this stage, the molder was able to experiment with methods of inserting the decorative overlays into the mold, (*To page* 254)

After press, with plastic transferred to mold, has remained closed for required interval, it is opened momentarily and printed melamine foil overlays, die-cut to size, are placed in position above and below part. Press is then closed again to complete cure

At end of cycle, press is opened and part slid off core. During last phase of the curing cycle, printed inserts have been fused permanently into surface of molded part. Removal of slight flash at parting line completes production of decorated section



Forming hermetic seal: At right is fully bolted assembly. Dark portion is deformed nylon sleeve. Note formation of "washers" at top and bottom of work. (Illustrations, Nyltite)

Critical components

How three different problems in three distinctive products were overcome by the use of nylon

Three recent applications of nylon give added emphasis to the design potential of this versatile material. In one, thin-gage nylon tubing is used to produce a hermetic, vibration-damping seal in bolt-type joints. In the second, molded nylon parts contribute importantly to the proper functioning of an automatic washing machine. In the third, 57 nylon parts shield all points of motion in an aluminum jalousie window.

In every instance, the parts, though small, perform crucial functions—and perform them better and more economically than other materials.

Full-time seals of nylon

The design for a water- and air-tight seal for bolted assemblies was developed by turning to advantage one of the "shortcomings" of nylon: its tendency to cold-flow under pressure. The seal involves a sleeve fabricated from a length of nylon tubing by folding it back over itself, with the fold constituting an outer rim flange. To effect a seal, the sleeve, long enough to extend from bolt head to nut before tightening, is either slipped over the bolt or dropped into the bolt hole. In the latter case, the rim flange prevents it from falling through. As the nut is drawn, pressure on the sleeve causes the nylon to cold-flow around all parts of the joint, forming washer-like disks at both ends and filling all spaces between the bolt and the work. In addition to serving as a seal, the sleeve can also be deformed into a buffer between two bolted plates; into grommets and bearings; and, in the case of nailed and screwed assemblies, into washers.

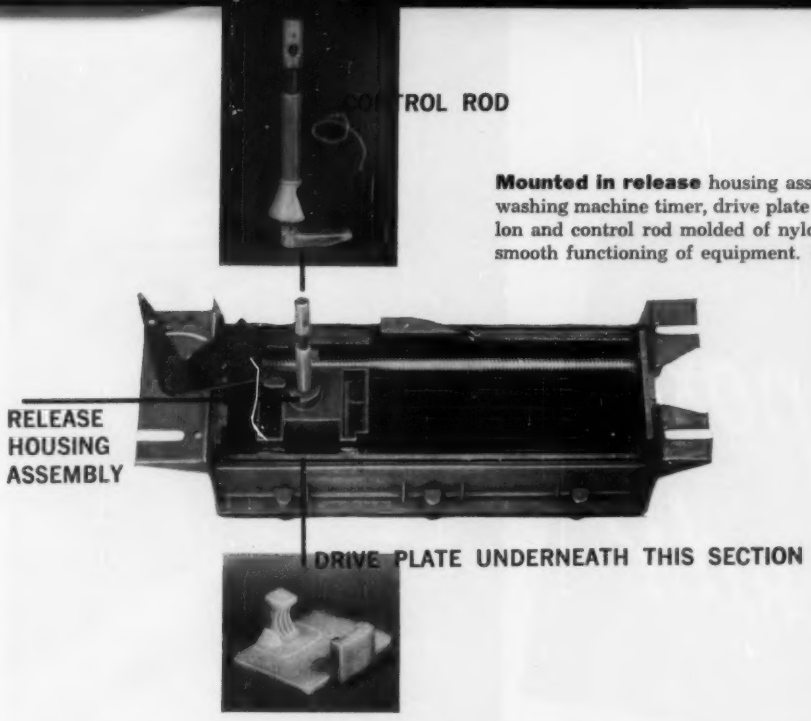
The design principle, on which patents are pending, was developed by William and Charma Gould, of Nyltite Corp. of America, Union, N. J., an affiliate of Keystone Plastics, Inc., and won first prize of $1000 in the recently conducted nation-wide design contest sponsored by Cadillac Plastics & Chemicals Co., Detroit, Mich. Nyltite is producing 30 different sizes in four different lengths at the present time.

Nylon in automatic washer

Drawing on firmly established advantages of the material, Norge Div., Borg-Warner Corp., Chicago, Ill., has incorporated two small but important nylon parts in the timing mechanism of its new automatic washing machines: one is a glass-filled molded drive plate that triggers the timing device and the other is a molded control rod (with molded-in steel insert for greater rigidity) that actuates the drive plate. The former part weighs only ¼ oz., the latter but a fraction of that weight. Despite their diminutive size, however, these components are essential to the optimum performance of the washers.

The parts are molded by General Electric Co.'s Plastics Dept., Decatur, Ill., of glass-filled nylon (supplied by Fiberfil, Inc., Warsaw, Ind.) and Zytel 101, respectively.

The drive plate has a screw thread molded into its upright members. This thread mates with a rotating screw in the timer assembly of



Mounted in release housing assembly of Norge automatic washing machine timer, drive plate molded of glass-filled nylon and control rod molded of nylon with steel insert assure smooth functioning of equipment. (Photos, G-E)

the washer. When the cycle is started, the drive plate is engaged with the screw and transmits motion to a release housing contact block, driving it across a cam surface and causing electrical circuits to open and close, actuating the various washing cycle phases.

The control rod has a double function: it engages the threads of the drive plate with the drive screw and also brings the contact springs of the driven mechanism into engagement with a series of control cams.

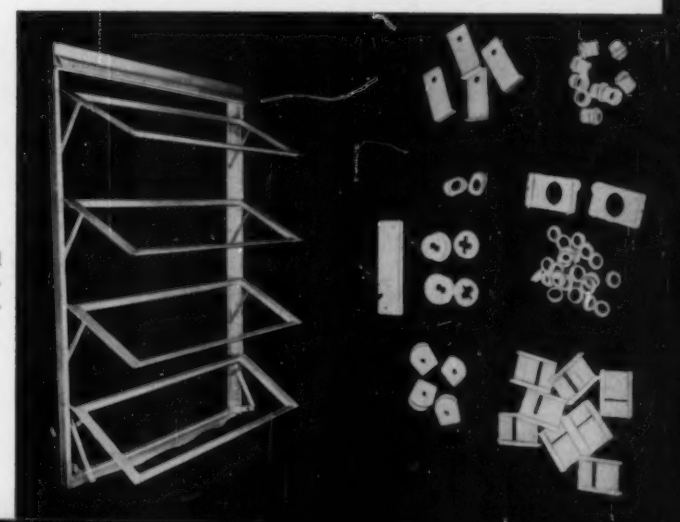
In this application, the self-lubricating properties of nylon permit low-friction mating of threads to assure quiet operation. Addition of glass filler acts to reduce cold flow. Field reports on actual performance indicate excellent wear resistance, good dimensional stability, and high strength. In spite of the advantages it offers, the molded drive plate is less expensive than the metal casting that was originally considered for this job—a casting whose properties would have been inferior to those of the nylon piece.

Corrosion-free bearings

Aluminum jalousie windows are fast replacing steel and wood. But in tropical climates and in the presence of sea air, moving aluminum parts have shown a tendency to become balky with age.

To overcome this difficulty, Vun-Russ Co., Inc., Hialeah, Fla., uses molded nylon grommets and bearing parts to eliminate all metal-to-metal contact at all points of motion. Every friction point, whether pivotal or sliding, has been shielded or bushed with a molded nylon component, insuring the user an everlasting smooth operation without the need of any type of lubrication.

The "Look" awning or jalousie window has nine different molded nylon parts making a total of 48 separate pieces; in addition, the Vun-Russ window operating mechanism has five different nylon parts for a total of nine pieces. Altogether 57 points of motion are rendered virtually friction-free by molded nylon. The parts are molded by Everglades Plastic and Security Plastics of Hialeah, Fla.

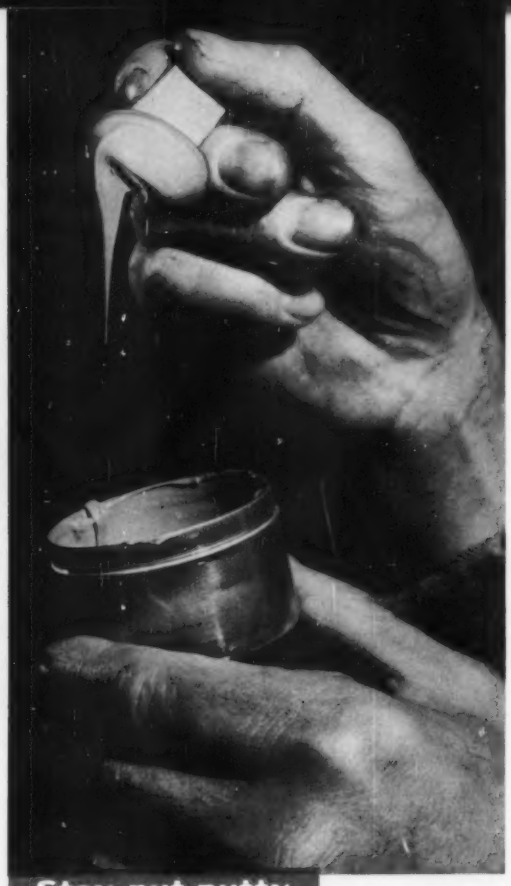


All pivot points in jalousie window are shielded or bushed with molded nylon parts (right) to insure long-time trouble-free operation and to eliminate need for lubrication. (Photo, Vun-Russ Co.)

Which epoxy compound?

Each end use requires a tailor-made material. Here is the how and why

*By James Tompkins**



Stay-put putty

Specially formulated epoxy putties have good thixotropic characteristics: once applied, they will not sag or run off, even on vertical or overhead surfaces. (Photo, Smooth-On Manufacturing Co.)

The use of solid epoxy resins in coatings and adhesives is now well established. Epoxies in liquid form, still relative newcomers to the field, seem to find new and different uses every day. Many companies, recognizing the potential for epoxy resins in various industrial fields, have tailored the basic materials for specific end purposes.

Plastic tooling

Casting Resins. Free-flowing epoxy compounds which are mixed with a hardener or curing agent just prior to use are well suited to a variety of casting applications. Chemical action between resin and hardener cures the compound to a strong, tough, infusible solid which reproduces faithfully the most delicate mold detail.

Castable epoxies are used successfully to make dies for vacuum forming. Original models, usually made of wood or plaster of Paris, can be duplicated in epoxy by simple casting techniques. Resin compounds for this purpose generally contain a large amount of powdered aluminum to reduce shrinkage to a tolerable minimum (a few thousandths of an in./in.), to improve machinability, and to increase heat dissipation.

The usual curing agents are sufficiently reactive to harden the compound at room temperature in a few hours so that the casting may be removed from the mold and then post-cured to develop heat resistance above 200° F. At the same time, these hardeners permit the casting of relatively large masses (2 to 3 in. thick) of material at one time without excessive exotherm (150° F.) so that a "plastic shot" taken from the original model can be used as the mold for pouring the die without danger of distortion.

Casting resins also enable the pattern maker to duplicate originals made of wood, metal, or

*Director of Research, Smooth-On Mfg. Co., Jersey City, N. J.

gypsum cements. Special techniques are used to obtain these reproductions without appreciable shrinkage. First, a negative plaster mold is made from the original pattern. A core is then fabricated of wood or epoxy to fit this cavity with about ¼ in. space allowed for an epoxy facing material. With the core in place, a free flowing epoxy compound is cast over the core. Thus shrinkage is restricted to a ¼-in. thickness, making possible pattern duplicates having less than a 0.001-in. differences in any dimension from the original.

Resin compounds used for casting face coats must be of low viscosity and contain only enough filler to impart abrasion resistance to the surface of the plastic pattern. By the same token, the hardener must be a low-viscosity liquid capable of curing thin sections readily at room temperature.

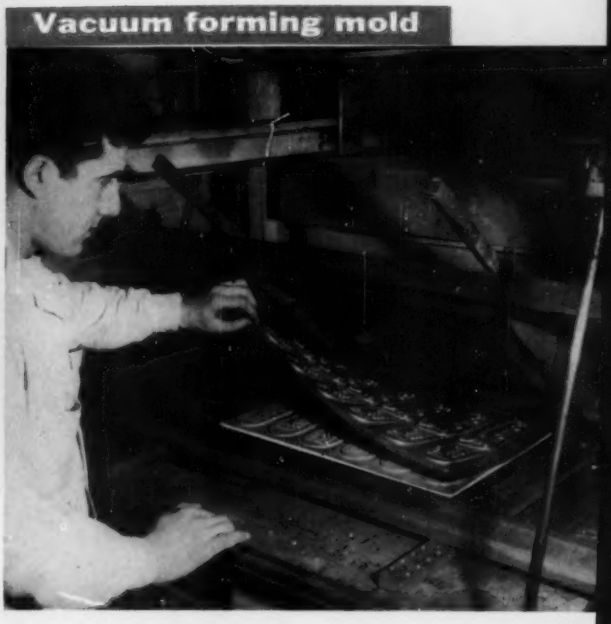
Castable epoxy compounds are used to make sheet-metal forming tools to handle light-gage material on hydraulic and drop hammer presses. For the die, the epoxy, heavily loaded with a filler such as aluminum oxide, is cast from a pattern. The punch is cast into the die after making allowance for metal thickness.

An alternative method for fabricating the punch frequently used for drop hammer operations uses a Kirksite core and a cast flexible epoxy facing ¼ to ½ in. thick. No provision is made for metal thickness since the flexible epoxy will compress to proper size. This method insures uniform pressure against the die surface and provides high impact strength to the drop hammer tool. Flexible epoxy compounds are normally supplied as two component systems, Part A being clear unfilled epoxy resin and Part B being a blend of hardener and flexibilizer. These materials are also available as three separate components where it is necessary to vary (widely) the degree of flexibility.

Various other plastic tools are cast from epoxy compounds. The list includes assembly fixtures, drilling fixtures, Keller models, welding fixtures, and many others. General-purpose epoxy compounds filled with aluminum powder are most widely used here.

Epoxy laminating materials. For optimum strength and dimensional stability in plastic tooling, the hand lay-up technique is used to form a fibrous glass-reinforced epoxy resin laminate over any contour. More or less the same method is used to fabricate such tools as bending forms, blanking dies, draw dies, checking forms, and stretch blocks.

To fabricate an epoxy-glass laminate, a coat



Free-flowing epoxy compound being poured over pattern (above) to make a vacuum forming mold for use with thermoplastics sheeting. At right, mold is shown mounted in forming machine for production work. (Photos, Emet Plastics Corp.)

Drill-press jig

Fixture mounted on drill-press table was cast from free-flowing epoxy formulation. It holds production pieces in position for angular drilling operations on metal castings

Trimming die

Used for trimming zinc castings, cast epoxy production die was less expensive as well as quicker and easier to make than the metal trimming die it replaced. (Photos, Smooth-On)

of epoxy is first applied over the surface to be duplicated to insure a smooth, void-free surface on the tool. Surface-coating resins can be formulated to permit brush coatings 0.030 to 0.060 in. thick on vertical surfaces without sagging and without excessive brush drag. For such plastic tools as drawing dies, which require surface hardness, the surface coating resin should have a filler such as aluminum oxide. Other surface-coating resins may contain pigments simply to provide color and opacity for such tools as checking fixtures. Surface-coating resins should be used with a hardener which cures thin films readily at room temperature and which has minimum toxicity, since some skin contact is unavoidable.

As the epoxy surface coat hardens, sheets of glass cloth are bonded to it using more epoxy. The laminating process is continued until the number of plies is sufficient to provide the required strength and rigidity. Where necessary, metal tubing is embedded in the laminate, using fibrous glass tape and resin to provide support and resistance to distortion. Plastic tools fabricated in this manner have high strength (25,000 p.s.i. flexural), and are dimensionally stable and light in weight.

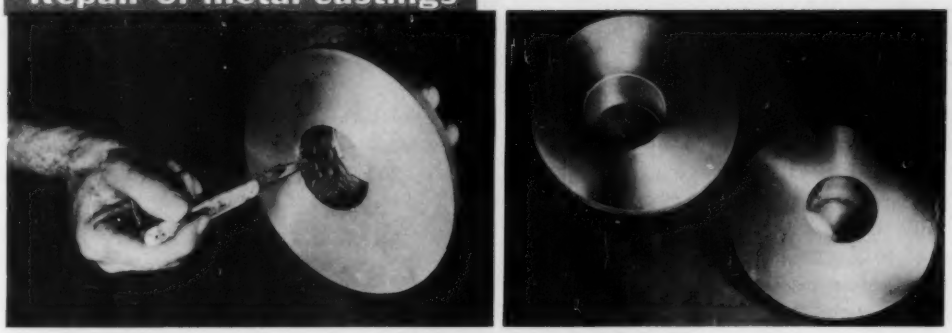
Paste-type materials. Epoxy resins can be formulated to provide a paste or grout-like consistency. Such formulations, upon addition of a hardener, can be applied by putty knife or trowel to a thickness of ½ in. or more and will cure without flow.

Large mock-ups or models built up with stationary templets can be formed to proper contour using this type of epoxy material. Expanded metal lath provides the foundation for a "splining compound-base coat." This base coat is a heavily bodied grout curing at room temperature with little shrinkage, which is smoothed to within 0.030 to 0.040 in. of the desired contour using a rubber squeegee-type screeding tool. After the base coat hardens, a "splining-compound finish coat" is screeded to the desired contour and is then allowed to harden.

These same grout-like materials can be used to form shells to many other applications. Following the application of a surface-coating resin, the necessary build-up can be troweled on instead of laminated with glass cloth. Plastic tools made in this way have adequate strength for pattern duplication, machine shop fixtures, and other uses.

The same general process can be used to build up the working face of a metal forming

Repair of metal castings



Paste-type epoxy compound is applied (left) to a defective area of a metal casting that was revealed during machining operations. Repaired casting, after final machining, is shown at extreme right, with a perfect casting to its immediate left. (Photo, Smooth-On Mfg. Co.)

die. In this proceedure, a surface coating is brushed on the model to provide a void-free, smooth surface. When cured, this is then reinforced with a troweled-on layer of grout-like epoxy, which is later backed up with a heavily filled casting resin.

Electrical embedments

In the electronics field, the number and variety of useful epoxy resin formulations seems almost limitless. Whereas most plastic tooling applications are based on room-temperature-curing systems, electrical encapsulations generally employ oven heat to obtain cured resins having a wide range of physical and electrical properties.

Casting resins. The most widely used epoxy encapsulating materials are based on liquid resins because of ease of handling. Generally a filler, such as mica or silica (to mention only two of many), is added to the resin for the following reasons:

1) To reduce shrinkage during cure, thereby lessening internal strain on embedded components and at the same time improving the resistance of the cured resin to mechanical and thermal shock.

2) To reduce the thermal coefficient of expansion of the cured resin so that it more nearly matches that of the encapsulated component, thus preventing failure during exposure to temperature extremes.

3) To increase the heat conductivity of the

Metal-working dies

After a surface coat of epoxy compound is brushed on model of metal-working die, thick layer of grout-like material is troweled on to serve as reinforcement for backing of tool. (Photo, Johns-Manville Corp.)

Pattern gates

Gates for chair-leg pattern were cemented in place with epoxy putty. (Photo, Smooth-On)

cured resin, and hence aid in the dissipation of heat generated by the electrical component.

The selection of a hardener to cure the epoxy resin compound determines in large measure the electrical and physical properties obtainable and the handling characteristics of the formulation.

Room-temperature-curing agents of the amine type are used when oven facilities are not available or when the component cannot be subjected to elevated temperatures. The pot life of such systems is short and the heat resistance of the cured resin is rather low.

Epoxy resin dip coat. Liquid epoxy resins for dip coating processes must of necessity have a very long pot life because large amounts are required to fill dip tanks. Such formulations must have a low enough viscosity to permit complete air bubble elimination under vacuum so that pin-hole-free coatings are obtained. The consistency must be such that the resin readily "bridges over" the component on dipping. Most important of all is the thixotropic quality of such material which enables dipped parts to be oven cured without sag or runoff.

Brush coats. Dip-coating resin formulations and, to some extent, formulations similar to the "surface-coating resins" used in tooling applications are sometimes used to provide brush coat insulation on large electrical gear.

Molding compounds. Although some successful work is being done with heavy bodied liquid epoxies to which a liquid hardener is added just prior to use, most molding compounds are in solid form. This means a solid resin-filler-hardener combination which liquefies under the heat and pressure of the molding process, then thermosets after injection into the cavity. Such materials are put into the molding machine either as a powder or as a pill or preform of exact size.

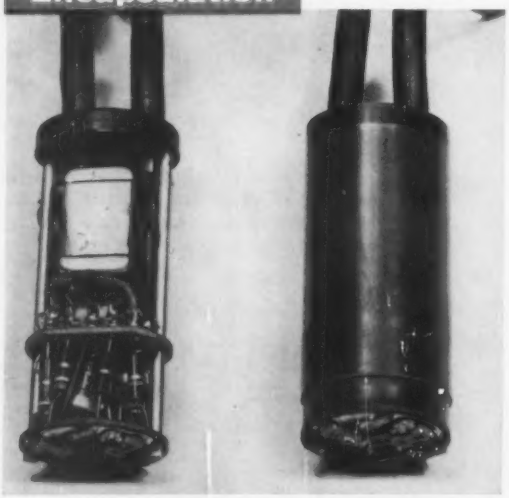
Cements

For the general industrial field, and, to a limited extent, the household field, there are presently available a number of epoxy resin compounds generally classified as cements.

Fairing compounds. These are highly thixotropic paste type materials which can be spread with a knife after the hardener is mixed in, then cured in place without flow even on vertical or overhead surfaces. These compounds contain a high percentage of thixotropic agent and are usually heavily filled with metal powders.

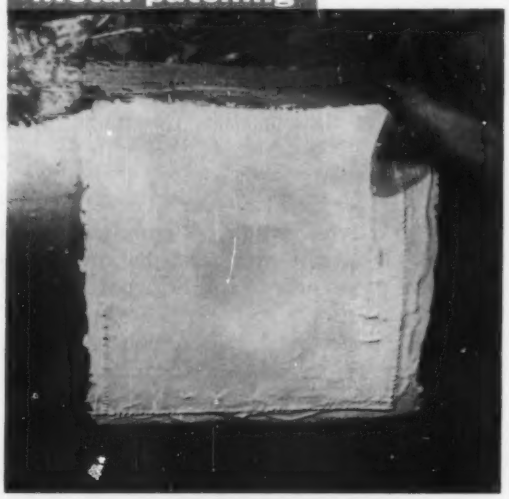
Fairing compounds find wide use as "aerodynamic smoothing putties" on aircraft for high speed operation. They are used over countersunk bolt heads or rivet heads, in seams—in short, wherever (*To page* 256)

Encapsulation



Headset adaptor before and after encapsulation in epoxy casting resin. Encapsulation is also possible by dip coating, brushing, and molding. (Photo, Trad Electronics)

Metal patching



Worn area in metal tank is patched with fibrous glass cloth shown here being saturated with catalyzed liquid epoxy compound. (Photo, Smooth-On Mfg. Co.)

Luxuriant, life-like leaves for plants that never wilt are vacuum formed from silk-screened polyethylene sheet (below). Stems are heat-sealed to leaves. (Photo, Stanley Bernstein; color plates, Bakelite Co.)

Vinyl plastisol and polyethylene sheet are cleverly used to produce

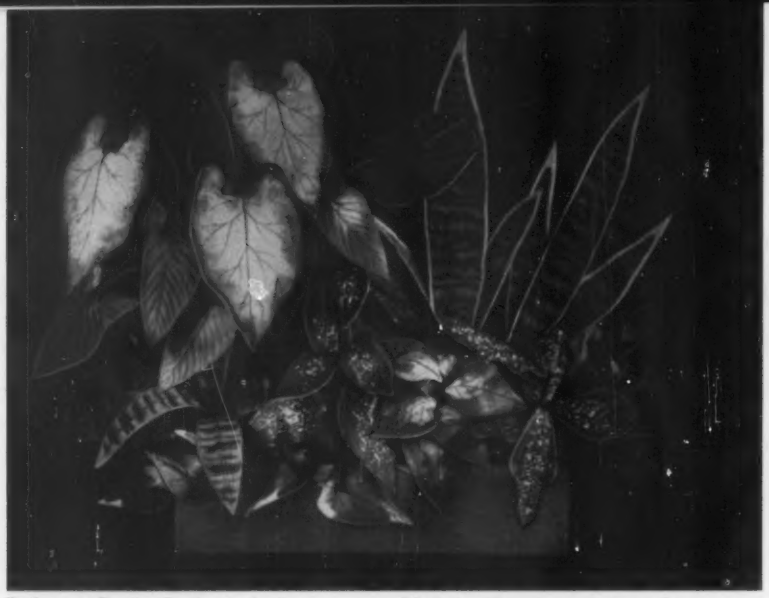
PERMANENT PLANTS

Through the use of specially formulated vinyl plastisols and formed polyethylene sheet, both with highly developed production techniques, several companies are turning out amazingly life-like plastics plants which appear to the observer to lack only the fragrance of their natural counterparts. And at least one major supplier of such plants is now producing lemons and leaves having an authentic lemon smell!

Growing market

It is estimated that sales of artificial flowers and foliage made of paper, the most commonly used material, run between $15,000,000 and $20,000,000 annually. Vinyl artificial plants, which first made their appearance only a few years ago, now represent approximately a $3,000,000 annual market and production is growing rapidly. The recent introduction of do-it-yourself kits based on vinyl plastisols should be an important factor in swelling this total.

Vinyl plastisol plants, although somewhat more costly than artificial plants made of paper, coated cloth, and similar materials, are superior to them in color, texture, and durability. The flexible plastisol leaves closely simulate those of a natural plant. Completely washable, the vinyl plants may be used either



Colors of vinyl plastisol plants are molded in. For some types of foliage, veining or other details may be placed in mold and given precure before basic leaf color is added. For variegated patterns, all colors may be placed in mold and cured together. (Photo, Popeil Bros., Inc.)

indoors or out, since they are not affected by temperature variations or exposure to sunlight and rain.

Public places and homes

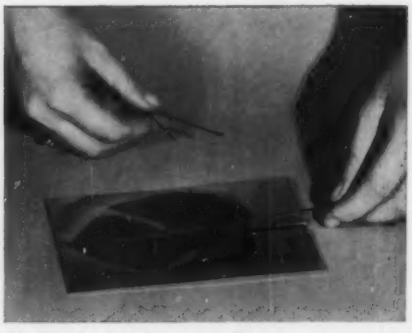
Although plastics plants first made their appearance in business offices, public lounges, theater lobbies, and similar locations, the increasing use of these plants in the home is a recent important trend. Homemakers, who may purchase the plants through variety stores, department stores, florists' shops, and interior decorating studios, are impressed by the fact that plastics plants eliminate many maintenance problems posed by natural plants and are actually more economical over a period of time.

Manufacturers of plastics plants have a virtually unlimited range of colors with which to either duplicate the hues of natural plants or, when desired, to turn out purely decorative plants having exotic coloration. The preparation of plant colors is one of the most exacting phases of this highly artistic business; most manufacturers either closely specify their particular color formulations or do their own coloring of the plastisol in the plant before molding. Formulations must also be closely controlled to insure that the finished plants will not become sticky upon exposure to sunlight and heat or brittle when exposed to low temperatures. Flame resistance can be built in.

Among the leading concerns now producing

How new do-it-yourself plant kit is used

First: Proper quantity of prepared vinyl plastisol compound is squeezed from tube into stamped aluminum mold provided with the plant kit



Second: Stem and vein wires are laid in position in mold; their function is to provide support in the finished leaf

vinyl plastisol plants and related products are Kendra Studios, Inc., Chicago, Ill., whose manufacturing plant is located at Waco, Tex.; Plastic Plants of Cleveland, Inc., Cleveland, Ohio; Popeil Bros., Chicago; and Marlo Studios, Chicago. All of these firms have their own closely guarded production setups, but work with basically similar plastic materials and techniques. Briefly, the production process involves preparation of the various leaf pattern molds, curing of the colored vinyl plastisol compound in the molds, and assembly of the leaves or flower petals into finished units, ready to be shaped and mounted in a planter box, room divider, or other plant container.

Vinyl plastisol plants can be produced in an almost limitless variety of shapes and colorations . . . and they are not flammable. (Photo, B. F. Goodrich Chemical Co.)

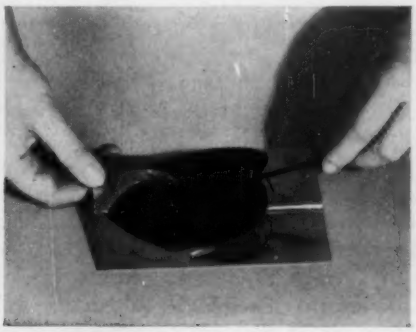
Art and technology

The production of plastic plants is today, and is likely to remain, a combination of art and technology. Although the actual curing of the plastisol into finished leaves is primarily a function of time and temperature, the preparation of the molds and assembly of the finished plants involve artistic talent and carefully directed handwork. For example, Arvid Strauss, proprietor of Marlo Studios, is a talented Swedish artist and sculptor who painstakingly carves his original leaf patterns in plaster as a preliminary step in the preparation of metal molds. Patterns are molded after actual plants, and must be true to life if the plastic reproductions are to look realistic.

Through a series of intermediate operations, the original carved pattern is converted into a cast alminum or electroplated mold. These molds usually include several leaf impressions to expedite production, and may run several feet in length. They are open molds and require no punch or male component, since no pressure is required in the curing process and no press is used.

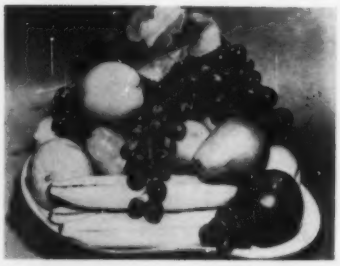
First step in production of the plastic foliage is to introduce liquid vinyl plastisol into the relatively shallow mold cavities, using small containers to accurately dispense the material. One or more supporting wires are then positioned in each leaf mold to form the stem and ribs of the plant. If two or more colors are required in the leaf, the exact procedure followed varies: Depending upon whether the colors are to blend or to maintain their separate identity, all colors are placed in the mold simultaneously or introduced separately and

Third: Metal mold is placed on hot plate or in oven for about 1 min. to cure plastisol. Stem wires are permanently bonded in place



Fourth: Cured leaf is lifted from mold by stem wire. Note how cleanly plastic leaf separates from mold, although no release agent is used

Fifth: Finished leaves are assembled on central stem to form complete plant. (Photos, Popeil Bros., Inc.)



Hollow vinyl plastisol fruit, produced by rotational casting, brings new dimension to realism of artificial fruits. Molded in appropriate basic color, fruit is later hand-decorated. (Photo, Kendra Studios)

Large plastics plants may have a dozen or more leaves and, when assembled, contain more than 1 lb. of plastisol. Leaves are molded with integral section at lower end of stem which forms buds in finished plant. (Photo, Marlo Studios)

given a pre-cure before the base color is added. When producing a heavily veined leaf having veins in a contrasting color, for example, the veined portions of the mold are filled first and pre-cured. Then the rest of the mold is filled with the basic color and the complete leaf is fused by application of heat.

Curing the foliage

Gas-fired ovens are usually employed for curing of the plastisol foliage; however, other sources of heat may also be used. Provision is made by the manufacturer to carry the metal molds through the oven area via conveyor. By using integral colors which are fused permanently during the curing process, the necessity of hand decorating the leaves with surface colors is eliminated.

Curing temperatures vary, but an average is approximately 375° F. Time cycles and temperatures must be carefully controlled in order not to spoil the colors of the leaves; lighter colors, in particular, are subject to color change if overcured.

Vinyl plant manufacturers use compartments or bins in which leaves of various sizes and types are grouped for convenient assembly. This process involves placement of the individual leaves on a central wire or wire-supported stem and wrapping with paper or green vinyl tape. In the assembly process, the worker gives close attention to proper distribution of leaves, leaf sizes, arrangement of buds (which are usually made by manipulation of the tape), and other details.

Since the types of foliage available from various suppliers runs the gamut from aspidistra to sansivieria and syngonium, organizing production into an efficient pattern requires careful scheduling. Usual practice is to use code designations for the various varieties and sizes of plants; these designations cover size of unit, number of leaves, coloration, and other details. One manufacturer, by way of illustration, offers ten selections of syngonium foliage, ranging from three to seven leaves, having heights varying from 8 to 12 in. and running from $1.00 to $2.50 in price.

For orderly and convenient shipment, the finished plant stems are left flat, so they can be easily formed into the natural leaf contours at the retail outlet, or when installed in a planter box, room divider, etc. Marlo Studios packs the finished plant components in counts of 12, protecting them by means of a folded paperboard sleeve stapled at the side. When plants are set up, they are frequently stuck into a block of green Styrofoam, which holds them securely and makes an attractive arrangement. Various specialized mountings may be worked out with driftwood or other components, depending upon the type of installation where the plants are to be used, the artistry of the arranger, and the (*To page* 258)

Rotary file is 'cook book'

Molded styrene unit, initially offered to the housewife, has industrial potentials

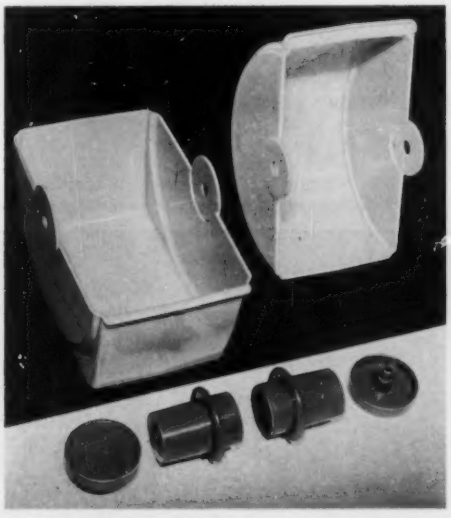
Thanks to an ingenious new application of molded plastics, the modern housewife now can locate and use her recipes as rapidly as her husband's secretary can find a letter in the file —possibly even faster!

The secret is the new Hi-Speed Cook Book recently introduced by *Household Magazine*, Topeka, Kan., and offered for sale to its readers. The unit is also available through department stores.

This modern "cook book" actually is a rotary file containing 1000 recipes printed on both sides of sturdy die-cut cards. Conveniently alphabetized and grouped under basic categories, the cards are made with two slotted openings at the base, permitting them to be easily removed from or replaced in the file. The card openings engage two molded-in ribs encircling the central spindle.

The parts of the cook book are injection molded of high-impact styrene. These include the attractively styled outer housing, made in two telescoping sections, and the supporting shaft, capped at each end by a knob. By turning these knobs, the housewife can immediately "dial" any desired recipe.

Designed by Charles E. Jones & Associates, Inc., Chicago, Ill., the new *Household* cook book is currently available in a choice of three color combinations—pink with black knobs, turquoise with light blue knobs, and yellow with black knobs. The molded plastic units, complete with 1000 recipes kitchen-tested by *Household's* food editors (*To page* 263)



Components of file: telescoping base and cover, two shaft sections, two knobs. (Photo, Service Plastics)

Recipes are dialed with turn of knob. Individual cards can be lifted off spindle and replaced. (Photo, *Household Magazine*)

Attractive and sturdy rotary recipe file is molded of high-impact styrene. (Photo, *Household Magazine*)

Formed acetate blister (right) is used to package toy accordion (top): blister is inserted through face of double cardboard sheet (left), accordion is put into blister, and assembly stapled at four corners to complete package

Roll-fed thermoformer

High degree of automation in machine that operates from a continuous roll of plastic sheet brings new economies to blister packaging operation

Sheet of acetate from roll at left indexes continuously into forming machine

To start new roll, operator positions sheet between two guides in forming machine, one on each side of mold. (Photos, Emet Plastics)

Costs were reduced 25% and production was doubled when a large acetate blister-packaging job was put on a new automatic thermoforming machine which is fed continuously from a roll of material. The job in point is a blister for packaging a toy accordion. It measures 9¼ by 8½ by 3¼ in. and is produced by Emet Plastics Corp., New York, N. Y., on a machine built by Auto-Vac Co., Fairfield, Conn. Present production is 28 blisters every 25-sec. cycle of operation. As one formed section is drawn from the machine to be cut off manually and later die-cut into individual blisters, another section of the sheet is pulled into position for heating and forming.

The machine was designed for production of large vacuum-formed parts at lower cost and in greater quantity than is possible with smaller machines. It uses a combination drape-and-vacuum forming technique and a tension feed to keep the sheet from sagging. The machine can handle 200-lb. rolls of any thermoplastic sheet up to 30 mils thick (polyethylene to 60 mils) and 44 by 72 in. in area.

Die cutting operation separates blisters from big sheet. Each blister is left with flange to facilitate mounting on cardboard base

ALPHABETS IN STOCK

Effective low-cost signs in all sizes are made possible by a wide range of plastics letters

By day, bright integral color of thermoformed letters 48-in. high gives visual impact to store sign. (Photos, Rhom and Haas)

By night, the individual letters are brilliantly lighted by back-mounted neon tubes

Plastics have shouldered their way to prominence in letters for signs because they offer a combination of advantages which no other material can match.

Individual plastics letters yield full color values by day and can be lighted internally at night. They're light in weight (which simplifies installation), non-corrosive, durable, and inexpensive—all prime considerations. Another selling point is their ability to combine good visual impact with "dignity," a quality important to banks, insurance companies, and similar institutions. Such firms are already well represented in the long and growing list of customers for plastics sign letters.

At any modern shopping center, chances are you'll find acrylic letters spelling out the names of the individual stores. And theaters are employing more and more butyrate marquee letters to announce the shows on their bills. Besides acrylic and butyrate, letters are also made of styrene, acetate, and polyethylene, but the first two materials are the important ones in outdoor applications thanks to their excellent weathering qualities.

Acrylics take lead

Acrylic is clearly the leading material for larger sign letters. Though figures are difficult to pin down because of the multitude of fabricators and the closed-mouth policy of the sign business, one educated source estimates that 20% of the 3 million lb. of acrylic resin to be used this year for signs will go into individual letters. Because of its impact strength, the material stands up well under the handling abuse which removable letters receive.

Old Style theater marquee signs, of cut-out metal plates with cast glass inserts, are dull in daylight, present breakage problems

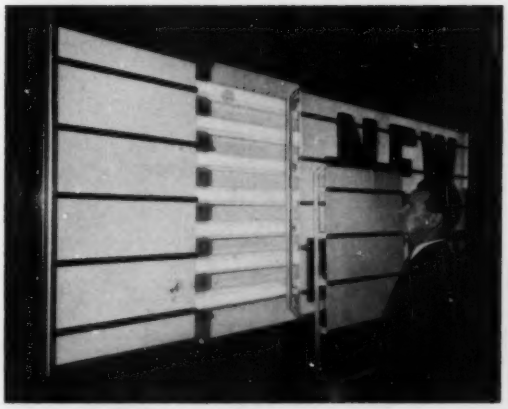
New type butyrate letters, bright red against a yellow acrylic background for daytime appeal, are low in cost, take rough handling

Butyrate, with its bright colors, brings daytime impact to the theater marquee. Conventional letters (made of cut-out metal plates with cast glass letters protruding from the openings) are "quite effective at night but dull and uninspiring during the daytime," in the words of a spokesman for Bevelite Corp., a Los Angeles, Calif., letter supplier. This company splits the sizable theater letter market with two other firms: Adler Silouette Letter Co., also of Los Angeles, and Wagner Sign Service, Chicago, Ill.

Besides their color advantage, butyrate marquee letters are less expensive and easier to handle than metal-and-glass letters. They are generally used against an acrylic background lighted from behind and are supported by metal tracks. Many applications for removable letters besides theater use are springing up. Wherever a business wants an attention-getting "bulletin board" to announce topical messages, changeable plastics letters are applicable. Such firms as supermarkets, laundries, drive-in refreshment stands, and other businesses are using butyrate letters to advertise daily specials or to post other notices, making changeable copy signs a fast-growing segment of the plastics letter field.

Acrylic sign letters are available today from ¼ in. high to 4 ft. tall, the largest stock letters, with enough gradations between to satisfy any need. On a custom basis, there is virtually no limit to the size letters obtainable. A full range of type styles, about 30, are offered in acrylic.

For small letters and numerals, especially where weather resistance isn't important, sty-



Background for changeable letter sign is made up of acrylic strips and metal tracks to which the individual letters are attached

Changeable copy sign with butyrate letters advertises day-to-day "Specials." (Photos this page, Bevelite Co.)

Vacuum formed translucent vinyl sign has integral track to hold changeable acetate letters snapped from sheets in foreground

Injection molded letters, ¼ to 4 in. high, are produced from various materials in multicavity molds. (Photo, Faulkner Labs.)

Largest stock letter, 48-in. high, is formed of acrylic sheet. Other letter is 12-in. high. (Photo, Durable Formed Products)

Marine applications of butyrate letters include boat names, replacing metal, decals, and paint for greater attractiveness and durability. (Photo, Florida Plastics)

rene, acetate and polyethylene are popular. Polyethylene letters have a convenient virtue —they can be nailed in place without drilling holes through the letters.

Production methods

Plastics letters are produced by a variety of methods. The smaller letters are usually injection molded in multiple-cavity molds. One firm in this field, Faulkner Laboratories, Tampa, Fla., uses molds that yield several hundred letters per shot in the smaller sizes. This company keeps a stock of over 3 million letters, varied as to style, size, and color. Materials used are acrylic, butyrate, styrene, and polyethylene. Another sizable supplier of small letters, Florida Plastics, Inc., Palmetto, Fla., sells "Kwickee" polystyrene letters which carry their own pressure-sensitive adhesive for quick attachment to sign panels. This firm also supplies butyrate characters for boat names and numbers. A big improvement over the paint and decals they are replacing, in terms of durability and attractiveness, butyrate letters are enjoying a boom in the marine field.

Larger plastics letters are fabricated by various thermoforming methods including the plug-and-ring process (sometimes combined with vacuum assist), drape forming, pressure forming over male molds, and vacuum forming.

Maple and mahogany are probably the most popular materials for the molds on which plastics letters are formed, because of their low cost. Metal molds are used for large production runs or where high precision (*To page* 262)

Braille in acetate

Simple, compact vacuum forming machine provides economical means of reproducing raised characters in thermoplastic sheet

"Page" of Braille consists of acetate sheet into which raised characters have been vacuum formed. (Photo, Eastman Kodak Co.)

It has been 150 years since Louis Braille first taught the blind to "read" by running their fingers along coded characters made up of raised dots on heavy paper.

But Braille, as an imprinting process, has its limitations. The cost of the metal plates used for the mass production of books and pamphlets makes the process uneconomical when less than a thousand copies are required. The only alternative is to hand-block the characters, one sheet at a time, with templet and stylus. What has been needed is a simple, economical way to reproduce Braille in quantities of a few dozen or hundred copies.

To answer this need, Product Packaging Engineering, Culver City, Calif., (*To page* 261)

Table-top vacuum former for producing Braille characters operates on household current. (Photo, Product Packaging Eng.)

Shower Maid folding tub enclosure consists of extruded polyethylene sections joined by water-tight aluminum hinges. Fixed panels at each end adapt door to all tub sizes

Extruded sections of polyethylene and styrene alloy bring new economy to

Folding shower doors

Folding plastic bathtub enclosures, which quickly convert any wall-to-wall bathtub into an attractive shower stall, now supplement the solid plastic panel type of by-passing doors which have already captured a sizable share of the tub enclosure market. Whereas in the past most plastic tub enclosures have been constructed of rigid flat or corrugated sheets of acrylic or fibrous glass-polyester material, these new doors are made up of narrow, interlocking sections which fold like an accordion so that they may be "stacked" against the wall at each end of the tub. Thus, while retaining the basic features of by-passing doors, they permit even more convenient access by allowing the doors to be folded completely out of the way.

Typical of these new style tub enclosures are the Shower Maid folding polyethylene tub enclosure, produced by American Shower Door Co., Inc., Hollywood, Calif., and the Tub-master door, made by New Castle Prods., Inc., New Castle, Ind., and composed of extruded sections of high-impact styrene material. An additional feature of the Tub-master door, which is also available as a shower stall door, is the fact that in a matter of seconds it may be converted from a folding to a rigid unit by snapping a hinged towel bar into position.

Tub-master door is made of extruded high-impact styrene panels with interlocking edges. By snapping a hinged "towel bar" into position (top photo), folding door is converted into rigid enclosure of by-passing sections. Releasing towel bar (bottom photo) permits door to be folded together

Both of these new plastic tub enclosures are designed for installation either by professional installers or by the "do-it-yourselfer." Considerably less costly than many of the custom-installed glass tub enclosures on the market, they are pre-assembled so they can be quickly placed in position, ready for use, as soon as the extruded aluminum supporting members have been mounted on the tub and walls.

The Shower Maid enclosure fits any recessed tub that extends from wall to wall. The shatterproof translucent polyethylene panels are available in four fashion-favored colors to suit virtually any decorative scheme—coral, pearl gray, sea green, and sky blue. All framing members of the enclosure are of aluminum. Mounted on rustless roller bearings, the plastic foldaway doors glide open at fingertip touch so that all parts of the tub can be reached for bathing infants, cleaning the tub, etc.

The polyethylene panels used in the Shower Maid doors are of variable cross section for increased strength and added beauty. They are continuously extruded to the exact width required, then cut to finished length. Along the edges of each panel is an integral bead which is fastened to a metal hinge, allowing the panels to fold and providing additional rigidity.

The Shower Maid enclosure comes completely packaged in a carton measuring 8 in. sq., 5 ft. long and weighing 31 pounds. By following the directions provided with each unit, any handy man can install the enclosure in half an hour or less. As soon as the two wall pressure plates and upper and (*To page* 265)

Installing Tub-master enclosure: folded halves are hung on aluminum supporting member from molded nylon rollers, and nylon guides are inserted in lower track; door is then ready for use

Comfortable pool pad

A colorful, non-sinkable pool pad combines light, flexible urethane foam with a smooth, waterproof vinyl covering. The pad weighs less than 2½ pounds but is said to have five times the cushioning quality of conventional materials. The pads may be used on chaise longues, seats, or boat bunks, for sunning, or as play floats in the water.

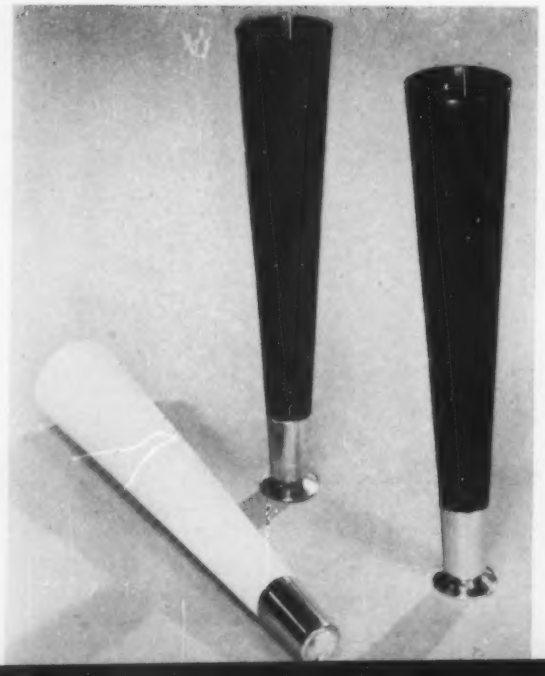
They are highly resistant to such poolside or beach conditions as sunlight, salt water, and chlorine, and to abrasion and tearing. Another especially attractive quality is that they may be washed with soap and water.

The pads, which measure 27 by 76 by ¾ in., are decorated with 1-in. wide alternating stripes of color and white on one side and are all-white on the other side. Colors include yellow, black, blue, green, and red.

Credits: Manufactured by American Latex Products Corp., Hawthorne, Calif.

PLASTICS

Molded furniture legs

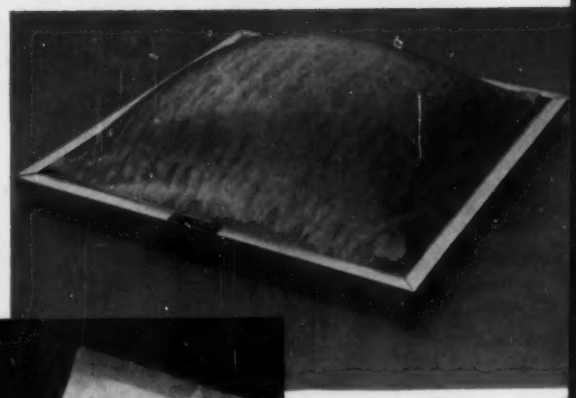


New approaches to the design of furniture bases are now possible with the introduction of a full line of molded plastic legs. Injection molded of styrene-acrylonitrile copolymer material, the high quality legs combine the desirable qualities of wooden and metal legs with the design flexibilities of shape, size, and color which are practicable with a readily molded plastic.

Though design can be custom tailored to the end-user's needs, the new line includes 18 standard models, including wood grains, solid colors, and novelty transparents and translucents. All of these are available in either glossy or velvet finish. The legs are produced in lengths up to 15 inches, but additional tooling is in progress to include lengths to 28 inches. A full assortment of shapes is offered in the line—round, oval, square, and to special design, to serve furniture manufacturers with specialized needs.

The styrene copolymer used for the legs has a

Controlled daylight



The translucent element of a new skylight is fabricated of acrylic embedded with a silver material to accomplish three things: reduce the amount of transmitted heat, eliminate glare, and "control" daylight. The Reflectadome is said to provide a uniform supply of natural light all day long. For example, when the sun is at an angle of 20 degrees, the dome transmits double the amount of light passed by a clear skylight; when the sun approaches 90 degrees at noon, transmitted light is reduced by 60 percent. The dome is also designed to improve diffusion throughout the interior area while it produces a lighting curve more nearly level than other skydomes. The Reflectadome is housed in an aluminum frame, with an extruded vinyl spacing strip. The frame has a self-contained sloping condensation gutter and a weeping gutter to allow for drainage.

Credits: Wascolite Reflectadome manufactured by Wasco Products, Inc., Cambridge, Mass.

PRODUCTS

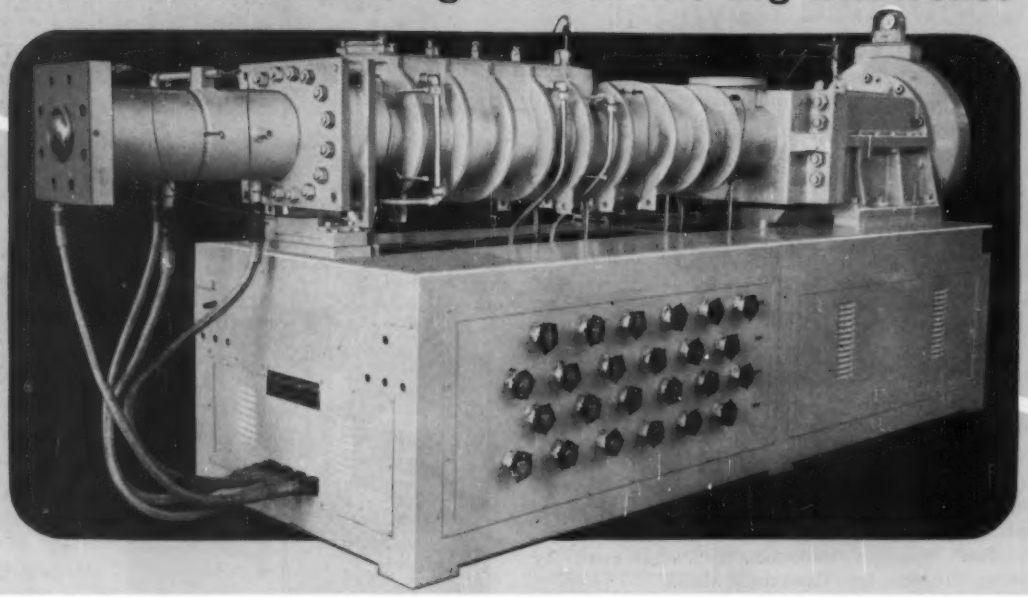
open new design channels

good balance of physical properties, including excellent resistance to chemicals and many solvents, good resistance to heat, and attractive surface finish. Tests have shown the legs to have outstanding strength and to resist marring and scratching caused by handling at the manufacturing level or by household use. When damage does occur to the legs, they can be repaired without the need for complete refinishing, since the color and grain are molded throughout the product, unlike wood or metal legs.

The legs are all produced in single cavity molds except for the smallest sizes, for which double cavity molds are used. They are adaptable to various types of mounting plates or may be used with their own flush mounting and are supplied with either plain or self-leveling type ferrules.

Credits: Stylar legs manufactured by Stylar Div. of Plastic Mold and Engineering Co., Providence, R. I., of Dow Chemical Co's. Styrex.

The Dual Worm Design Makes the Big Difference



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Norristown, Pennsylvania

Dr. James F. Carley, Engineering Editor

Fig. 1: Machines used in studying molding of rigid polyethylene

Injection molding rigid polyethylene

By J. V. Smith† and J. N. Scott†

Since the discovery of Marlex[1] 50 rigid polyethylene approximately three years ago, considerable information has been accumulated about the equipment modifications and techniques best suited to molding this material.

The information on which this article is based was to a large extent obtained with the injection molding equipment shown in Fig. 1, above: a 2-oz. Automolder (50-T), a 3-oz. Fellows (1B3-15), an 8-oz. Reed-Prentice (10D-8), and a 12-oz. HPM (300H-12).

Articles molded of rigid polyethylene are characterized by the inherent properties of the basic resin which include rigidity, toughness over a wide temperature range, excellent chemical resistance and electrical properties, good abrasion resistance, nontoxicity, and autoclave sterilizability. These and other characteristics are particularly desirable in the industrial items shown in Fig. 2, p. 150, the hospital and laboratory ware in Fig. 3, p. 150, and the housewares in Fig. 4, p. 150. The physical properties of rigid polyethylene of particular importance to injection molding are given in Table I, p. 154.

Injection molding technique

Rigid polyethylene can be injection molded readily in conventional equipment currently used throughout the plastics industry. Many of the general practices and rules employed with other thermoplastics on the market also apply in molding rigid polyethylene. In order to obtain optimum quality in moldings, however, there are several factors which

*Reg. U.S. Pat. Off.
†Plastics Sales Div., Phillips Chemical Co., Bartlesville, Okla.
[1]A trademark for Phillips' family of olefin polymers.

Figs. 2, 3, 4: High ratios of strength, stiffness, and toughness to weight; good formability; and chemical inertness make rigid polyethylene ideal for (top to bottom) industrial, hospital, and houseware products

merit special consideration. These factors are discussed in some detail in the following sections.

Feeding methods: An accurate material-metering device such as a (timed) vibratory feeder or preferably a weigh feeder is a desirable part of the equipment to be used for molding rigid polyethylene. These devices are usually adjusted to feed to the cylinder the exact amount of material that is required to fill the mold cavity with each shot. This technique, commonly known as starved or exact feeding, prevents the build-up of a resin cushion in front of the ram after the mold cavity is filled. This system of feeding offers the following advantages:

1) Mold packing is minimized, thereby reducing any tendency toward warpage or lowered impact strength in the gate area.

2) Molded parts are usually more uniform from cycle to cycle.

3) Higher cylinder temperatures and injection pressures can be used without flashing the part.

4) A minimum of material is used for each shot.

These advantages are more pronounced in the molding of thin-walled items. In molding items with thick sections (greater than approximately 0.125 in.) from rigid polyethylene, it is often necessary to pack the mold to prevent the sink and void formation associated with resins having high mold shrinkage. When mold packing is necessary, accurate material feeding is less important.

Cylinder temperatures: Rigid polyethylene is injection molded at stock temperatures from 300 to 600° F. depending on the mold and equipment. Generally, temperatures from the upper part of this range (450 to 550° F.) are desirable to facilitate filling large cavities and obtaining good surface gloss and minimum injection time. These higher temperatures are usually required when molding thin items in cavities that are difficult to fill. Temperatures higher than 500° F. are not recommended for molding rigid polyethylene, since little improvement in flow is realized at higher temperatures, while the risk of degradation is increased. For molding thick items in cavities which fill easily, lower stock temperatures are preferred. This is especially true where sink or void formation may occur. In general, it is desirable to operate the rear zone of the cylinder from 25 to 50° F. hotter than the forward zones in order to plasticate the resin more rapidly and to reduce the pressure drop between the injection plunger and the mold.

In addition to affecting the processability of the resin and the appearance of the molded part, the cylinder temperature, within certain limits, influences the physical properties of the molded part. These differences in properties can be attributed to: 1) a high degree of orientation of the molecules and crystallites in specimens molded at the lower temperature, and 2) a slightly higher crystallinity of the parts molded at the lower cylinder temperatures. The high orientation is in the direction of flow, and may not reflect over-all part strength. A schematic illustration of oriented molecules and crystallites is given in Fig. 5, opposite.

These effects are not great, and for many molded parts may not be significant. For example, the tensile strengths of end-gated specimens molded from rigid polyethylene vary from approximately 4300 p.s.i., molded at 500° F. cylinder temperature, to approximately 5500 p.s.i., molded at 300° F. (see Fig. 6, opposite).

From these illustrations it is apparent that the components of the oriented system would more equally share applied stress in the direction of orientation, and the system would be stronger (in the direction of flow) than the unoriented system.

Injection pressure and speed: The maximum practical injection pressure and speed are usually desirable for molding rigid polyethylene. For many molding jobs, this is possible only if accurate feeding and injection timing devices are available to prevent mold flashing. Some of the advantages of this type of operation are as follows:

1) The mold cavity is filled with resin more nearly uniform in temperature, thereby producing a molded part uniform in density, strength, and dimensional stability.

2) Much better surface gloss is obtained.

3) Filling of larger cavities is possible.

4) Any tendency toward warpage is reduced.

5) Mold shrinkage is kept to a minimum.

6) Minimum cycle time is made possible by the short injection time.

Where these factors are not critical, as in molding thick items, comparatively low pressures and speeds are usually satisfactory.

Mold temperatures: Ideally, the molding of rigid polyethylene consists of filling the mold rapidly with material at a uniform temperature and subsequently cooling this material at a uniform rate. The maximum uniformity of cooling is usually best accomplished by maintaining the cavity surface at as near a uniform temperature as possible during the molding cycle. In a normal injection molding operation, however, there is a tendency toward a heat build-up in the gate region of the mold. This build-up results from two things: 1) viscous working of the material in restricted gates, and 2) constant displacing of the part of the mold contents near the gate by inflow of fresh, hot material on its way to other parts of the cavity.

In order to approach the ideal conditions mentioned, it is necessary to remove more heat from the mold in the gate area than from the extremities. This can be accomplished with a spiral cooling channel (see Mold design section, p. 155), or by circulating low-temperature water (70 to 100° F.) in the vicinity of the gate, and higher-temperature water (160 to 200° F.) in channels near the extremities of the mold. This type of mold temperature control is particularly beneficial when warpage or less-than-optimum impact strength in the gate area is encountered.

The optimum mold temperature for rigid polyethylene is dependent upon the item being molded. Temperatures in the range from 100 to 200° F. are usually satisfactory, but are not to be considered as limiting. Mold temperatures ranging from those obtained with refrigerated water up to 250° F. can be employed. The high temperatures are de-

(*To page* 154)

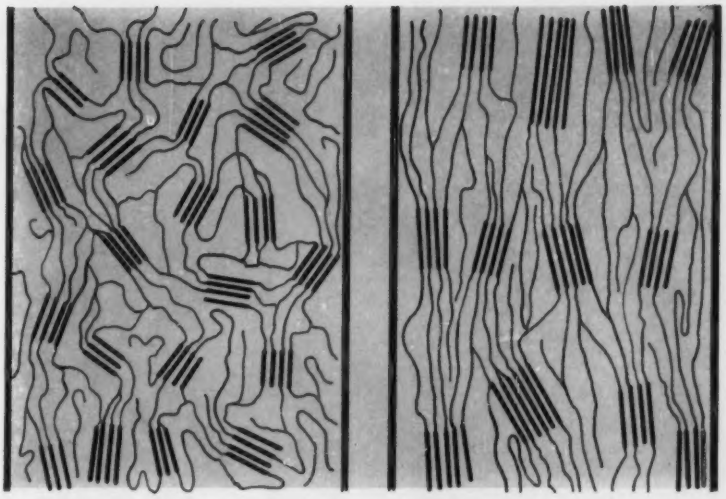


Fig. 5: Diagram at left is schematic representation of a partly crystalline polymer in the unoriented state. When unidirectional stress is applied, chains and crystallites are aligned, or oriented, in the direction of stress, as in the right-hand sketch

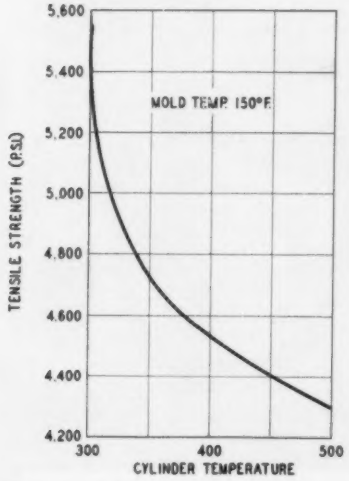


Fig. 6: Tensile strength of rigid polyethylene in direction of flow decreases by about 20% as cylinder temperature is raised from 300 to 500° F.

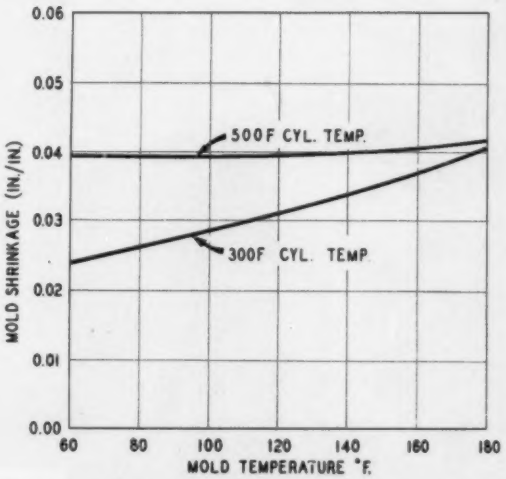
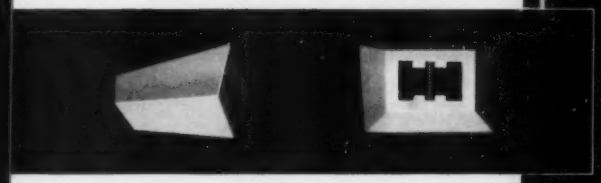
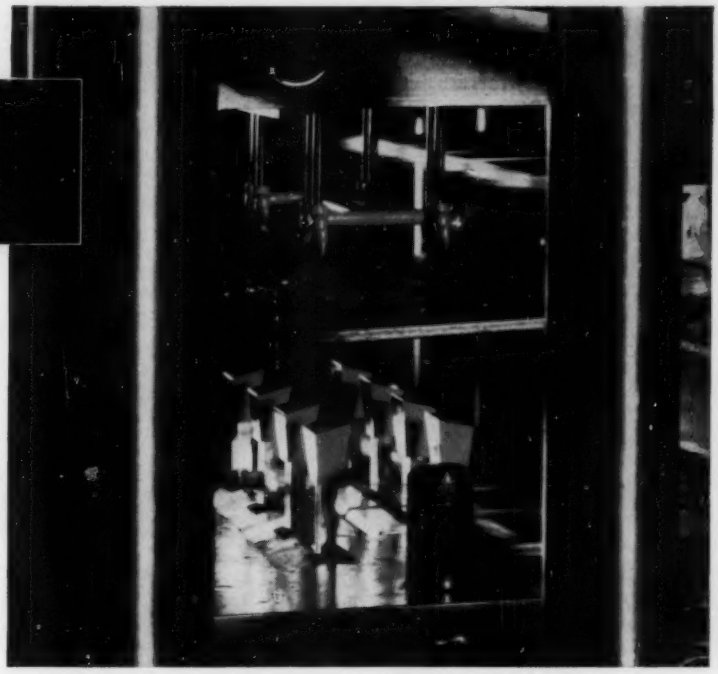


Fig. 7: Mold shrinkage of rigid polyethylene is more severely affected by changes in mold temperature when cylinder temperature is low, due to freezing-in of flow orientation. At high mold temperatures, cylinder temperature changes have little effect on shrinkage

The Stokes Model 701 installed in the plant of the Emeloid Company. Its simplified, fully automatic operation requires minimum attention.



Typical pushbutton produced on the Stokes 701. Note the tapered design and the clinch-type mounting hole. This finished product has had the hot-stamped legend applied.



A close-up of the die table showing the eight parts, simultaneously produced, about to be stripped off. Note the sprues and runners above the separating plate —these will be delivered through a separate chute to the scrap collection bin.

Emeloid produces millions of better parts—at lower costs—with a Stokes 701 Injection Molding Press

Fully automatic injection molding with a Stokes 701 enables this custom molder to increase production by 20%.

The Emeloid Co., Inc., of Hillside, New Jersey, has been a custom molder of plastic products since 1919 —with over a quarter of a century experience in injection molding. They recently installed a Stokes 701 Automatic Injection Press for high speed production of pushbuttons for home appliances. The wisdom of the investment has been proven by a 20% increase in production with the same number of mold cavities.

Fully automatic operation of the Stokes 701 enables Emeloid to produce better parts—with a lower reject rate and higher production yield. The better quality enables them to perform faster, more satisfactory after-operations such as the hot stamping of identification legends.

Extremely simple tooling of the 701 requires less expensive molds—reduces changeover costs. The precision operation provides a higher degree of uniformity and quality of finished parts. Fully automatic, this press requires less attention, produces on faster cycles and with higher efficiency.

Stokes patented ejection system positively clears all parts and runners from the die. Secondary protection is provided by use of the more common low-pressure close. Completely self-contained, the vertical design of the 701 saves floor space—permits easy sorting and separation—facilitates mold set-up.

Write for your copy of literature on the Stokes 701 —the truly automatic 2-ounce injection molding press. Ask for a Stokes production analysis on your own parts.

Plastics Equipment Division
F. J. STOKES CORPORATION
5500 Tabor Road, Philadelphia 20, Pa.

STOKES

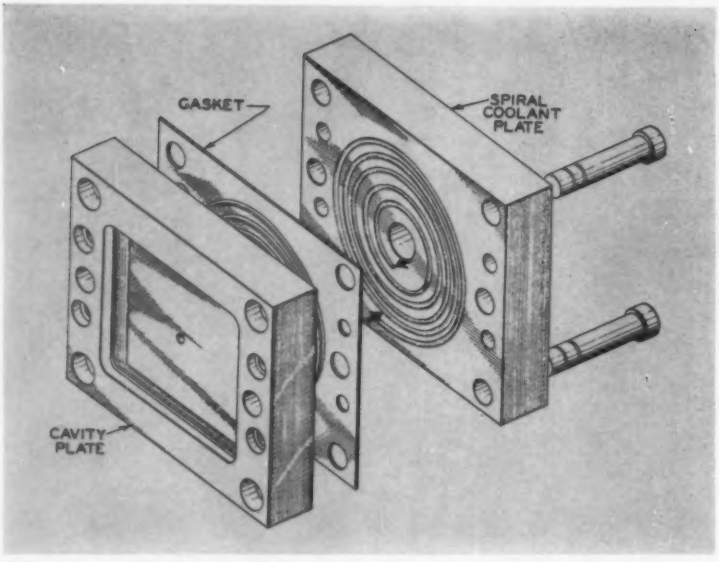


Fig. 8: Cavity plate with spiral-type cooling channel. Cold water enters near gate where melt is hottest, warms as it reaches cavity boundaries where melt has already somewhat cooled. This helps to reduce the difference in piece temperature from one part of the cavity to another

sirable for obtaining optimum surface gloss, prevention of void formation in thick sections, and achieving best dimensional stability at elevated temperatures. Where surface gloss is less important, lower temperatures may be desirable in order to obtain a shorter cycle.

Cycle timing: The time cycle, as with other molding variables, is governed by several other factors: 1) the thickness and over-all size of the molded part, 2) the size and speed (particularly ram speed) of the machine, 3) mold design, 4) the temperatures employed, and 5) in some cases, the plasticating capacity of the machine.

Freezes sharply at 250° F.

Rigid polyethylene, having a comparatively high solidification temperature and being rigid below this temperature, can be removed from the mold while relatively hot, and therefore requires short cycle time. The ram-forward time for all except very thick items need be no longer than the time required to fill the mold cavity. The clamp, or mold-closed time requirement for relatively thin items is perhaps shorter than for most other thermoplastics because parts solidify rapidly and retain their shapes at temperatures up to 250° F.

The transition temperature from molten to solid resin is sharp due to the inherently high crystallinity of the linear polymer. At 250° F., however, there is considerable heat of crystallization to be removed before the part is completely solidified, and a slight lag, depending on section thickness, occurs in the cooling rate. This factor is not detectable in thin items and even with moderately thick items the part temperature is reduced below 250° F. almost immediately after the completion of injection.

Although the time cycles required for rigid polyethylene are often shorter than those for other thermoplastics, there are some types of items which require longer cycle times when molded of this resin than with some of the high-flow plastics. Typical examples are very large items requiring long plastic travel and items thicker than about 0.125 inch. The factors contributing to the longer cycle times for rigid polyethylene in these items are:

1) Rigid polyethylene has a higher melt viscosity than the high-flow thermoplastics, typified by certain polystyrenes and high-melt-index, flexible polyethylenes. Due to higher viscosity, a longer injection time is required. This is not detectable except on long-flow items.

2) Rigid polyethylene, because of the high softening temperature and high melt viscosity, requires higher molding temperatures than the low-softening, high-flow plastics. In thick sections, the removal of this heat in the mold takes slightly longer than other plastics.

Mold design

Rigid polyethylene can be molded satisfactorily in many molds in use for other materials

Table I: Molding properties of linear polyethylene

	Value	*ASTM test method*
Melt index	0.6-0.8	D 1238-52T
Density, g./cm³	0.958-0.962	—
Softening temperature, °F.	260	—
Heat distortion temp. at 66 p.s.i., °F.	165-175	D 648-45T
Linear coefficient of expansion, in./in., °C.	1.3×10^{-4}	—
Mold shrinkage, injection, in./in.	0.02-0.05	D 955-51
Thermal conductivity, cal./cm., sec., °C. (over range 27-110°C.)	12.4×10^{-4}	—
Heat capacity = A+BT (over range 140-180°C.)		
A, cal./g. °C.	0.545	—
B, cal./g., (°C.)²	0.53×10^{-3}	—
T = temp., °C. (over range −17 to +46°C.)		
A, cal./g., °C.	0.383	
B, cal./g. (°C.)²	2.00×10^{-3}	
Heat of fusion, cal./g.	*ca.* 23	—

throughout the industry. However, best results will be obtained by designing new molds for this unique material. Where problems such as warpage and difficulty in filling molds are encountered, the modification of a mold or the construction of a new one is necessary. Modification is usually simple, such as the addition of cooling channels or the relocation of gates. Some of the factors to be considered in modifying existing molds or designing new molds are discussed in the following paragraphs.

Shrinkage factors: In designing molds for Marlex 50 polyethylene, it is sometimes necessary to compensate for the relatively high mold shrinkage of the material by making the cavity oversize. As can be seen from Fig 7, p. 151, the mold shrinkage of this material is dependent upon the conditions used. This shrinkage is not necessarily the same in all directions, and is usually slightly greater in the direction of fill.

These data were obtained on a 0.25-in.-thick heat distortion bar, and probably do not hold exactly true for thin items. If extremely close tolerances must be met, it is sometimes desirable to make the cavity slightly under the required dimensions and check for mold shrinkage under actual molding conditions before the mold is hardened and the surface is finished. With the information gained from such a test, the cavity can then be machined and finished to the exact dimensions required for molding the part to the required sizes.

Water channeling: To achieve optimum properties in molded items and at the same time obtain short cycles, it is important that molds have water channels located in positions which will give maximum temperature control of the surface of the cavity. This is usually not achieved with water channels located at random. On the other hand, if the design of the mold restricts the water channels to random location, it is desirable that they not be located too near the cavity surface. Such an arrangement will produce hot and cold areas on the cavity surface and aggravate the non-uniform cooling of the part.

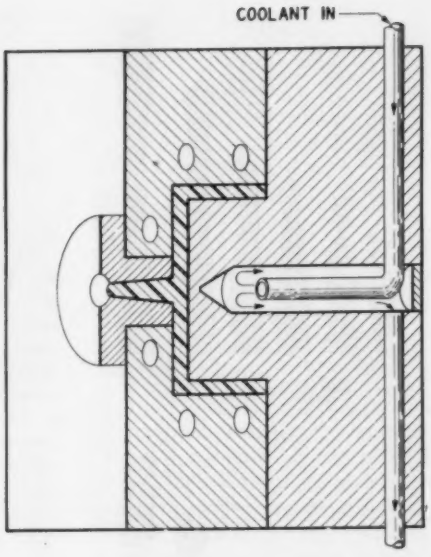


Fig. 9: Bubbler-type cooling is opposite gate in center-gated cavity

For most center-gated molds, good temperature control can be achieved with a spiral cooling arrangement similar to Fig. 8, opposite, with the spiral channel from 0.5 to 1 in. from the mold surface. With this type of channel, the cooling water must enter near the center of the mold and flow toward the outside, thereby permitting longer residence time of the water in the mold and transferring the heat build up from the center of the mold toward the outside. This to some degree balances the heat transfer away from the plastic in that the hot plastic enters the mold at the center and cools more uniformly as it flows throughout the mold. Water channeling similar in location and effect can be incorporated in side- and end-gated items.

If this type of mold channeling is not practicable, it is desirable to have separate channeling for the gate area and the periphery with the gate channel near the cavity surface and the outer channel farther back in the mold plate. A bubbler type channel in the core (Fig. 9, above) and circular channel around the sprue bushing (Fig. 10, below) are preferred over straight-through channels in the gate region.

Surface finish: Rigid polyethylene gives excellent impressions of

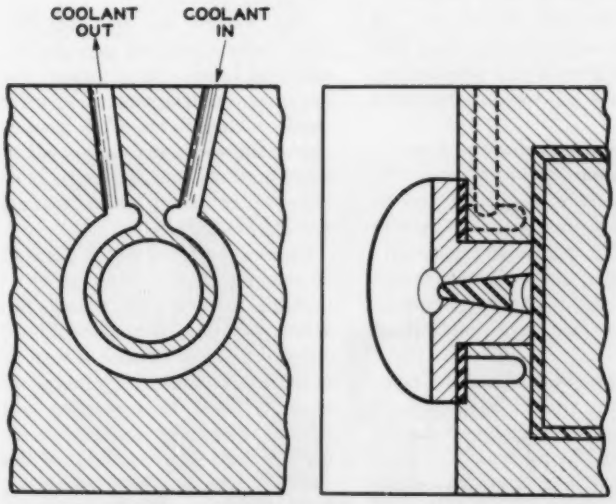


Fig. 10: Ring-shaped cooling channel around sprue bushing helps prevent overheating of metal in gate area

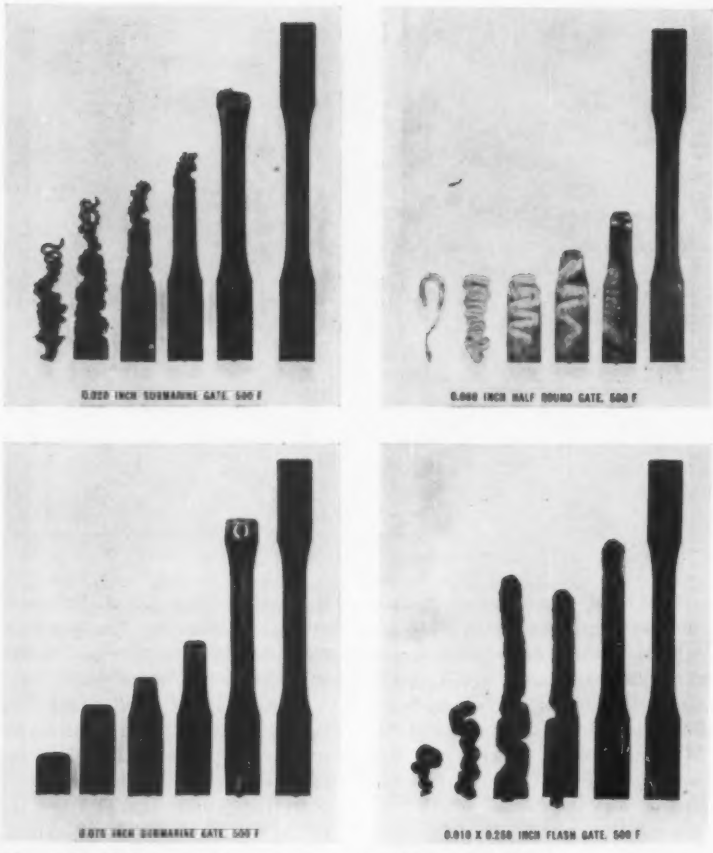

0.020 INCH SUBMARINE GATE, 500 F
0.060 INCH HALF ROUND GATE, 500 F
0.075 INCH SUBMARINE GATE, 500 F
0.010 X 0.250 INCH FLASH GATE, 500 F

Fig. 11: Modes of melt flow into a test-bar cavity fitted with gates of different shapes and sizes. Surface finish of completely filled shots depends on mode of flow as well as on filling time. (Illustrations, Phillips Chemical Co.)

mold surfaces. Where a very glossy surface is desirable, the mold cavity must be well polished. Any scratches or other imperfections on the mold surface will be evidenced on the molded part. The resin also gives finely detailed reproductions of various textured surfaces.

General cavity design: A number of good practices in cavity design assist in rapid fill and in minimizing pressure drop in the mold. Many of these are commonly employed in designing molds for other resins. A few generally good practices are mentioned here.

1) The length of sprue and runner systems should be kept to a minimum and the diameter should be as large as practical.

2) A slight increase in cavity depth in the gate area is desirable.

3) The choice of optimum gate design, size, and location is very important. Other factors vary from one mold to the next and do not apply generally.

Gate design, size, and location: The choice of proper gate design, size, and location is of utmost importance in designing molds for rigid polyethylene. This proper choice increases the ease of fill in large cavities and improves both the quality of the part's surface and its srength.

Gates should usually be located as near the center of the cavity as possible to facilitate uniform fill. When possible, the gate should enter the cavity in such a way as to cause the plastic to impinge on a cavity wall. This practice will help to reduce the undesirable effects of jetting, or snaking of the polymer into the mold as shown in Fig. 11, above.

The gate size and shape will depend on the size and shape of the item to be molded. In general, the gates should be round, have short lands, and be as large as practical. In molds for side-gated items, sub-surface (submarine) gates up to 0.075 in. offer ease of trimming and better part surface than half round surface gates.

The side of a gate should not be in the same plane as a surface of the cavity proper. The turbulence created by such an arrangement produces a dull, undesirable surface on the item molded. Fan or flash type gates are usually undesirable for molding rigid polyethylene. Jetting is pronounced and surfaces are often less than the maximum in gloss.

Although pin-point gates restrict the maximum cavity size and increase molded-in stresses, they are often desirable for molding small, thin items in that color dispersion is better than with large gates. The effects of the gate size and shape on cavity fill and surface are illustrated by the photographs of tensile specimens in Fig. 11.

The effects of gate design and size on direction of shrinkage, warpage, and impact strength was investigated and reported by Rielly, Hill and Jones (SPE J. *13*, 28, April 1957).

Ejection of parts: Ejection of molded parts is not a problem with rigid polyethylene in that there is no tendency for sticking to mold surfaces, even when mold release agents are not used. Conventional knock-out pins, properly located, are ideal for the ejection of flat sections. Ring or air ejection is preferred for deep-draw items; for some items of unusual shape, a combination of ejection methods is best.

Summary comments

The recommendations contained in the foregoing sections are of necessity broad and general. It should be kept in mind that recommendations helpful in one molding application may cause trouble in another; a balance of conditions is necessary to obtain the optimum balance of characteristics in the molded part. The best conditions must be determined individually for each injection molding operation.

Sintered nylon

*By Louis L. Stott**

Nylon powders precipitated from solution can be pressed and sintered into many useful shapes. Because of the high crystallinity of the material as compared with the injection molded product, it has superior frictional and wearing qualities and higher compressive strength, though its tensile strength, elongation, and impact strength are lower than those of molded nylon. Various additives and fillers are easy to blend thoroughly with the fine nylon powders, making possible a wide range of compositions. Fillers such as molybdenum disulfide even enhance the wearing qualities while sharply reducing the dimensional sensitivity of the mixture to changes in temperature and humidity. The sintered nylons are thus excellently suited to frictional applications, particularly where reliable lubrication is difficult. Possible shapes, pressing and sintering techniques, and dimensional tolerances are discussed.

Articles made from sintered nylon (see Fig. 1) have been available commercially for several years. Such pieces are made by cold molding at high pressures in excess of 10 tons/sq. in. (t.s.i.) followed by a heating or sintering cycle. Thus the processing steps required are more like powdered metal processing than standard plastics molding procedures; to date, therefore, powdered metal processors have shown more interest in the method than have plastics molders. Patents covering the process have been issued in the United States and a number of foreign countries(1).[1] Several licensed processors are now custom molding industrial parts.

Sintered nylon was originally conceived as a practical means of reducing the dimensional instabilities found in injection molded polyamides(2). The relatively high dimensional sensitivity of these materials to moisture(3) and temperature have often been troublesome problems to designers. In addition, molded-in stresses, if not relieved, have sometimes caused erratic size changes in molded pieces over a period of time after removal from the mold. It has been found, however, that if nylon is processed as a powder at a temperature below its melting point, this latter difficulty can be minimized. Furthermore, by using powder techniques it is possible to blend uniformly many types of fillers with nylon to reduce thermal and hygroscopic problems.

It has not yet been possible to obtain satisfactory bonding by cold pressing and sintering polyamide powder made by mechanically grinding molding pellets. Repeated tests indicate that it is necessary to prepare the material by chemical precipitation to obtain satisfactory strength in a sintered article(4).

Wears better than molded nylon

The precipitation of the powder from high-temperature solution gives a product having a relatively high percentage of crystallinity throughout its mass, usually in the range of about 80 percent. Injection molded nylon articles often exhibit a highly amorphous skin layer resulting from quick cooling of the molten material against a cold die surface and normally have an average overall crystallinity of about 43 percent.

Although this skin condition does no harm in many applications, it appears to be detrimental where minimum wear and best load-carrying capacity as a bearing material is required. Laboratory and field tests indicate that sintered nylon with its more highly crystalline wearing surface will operate under conditions of minimum lubrication at higher pressure-velocity (PV) values

Fig. 1: Samples of nylon powders and parts made from them. Powder at top left is filled with molybdenum disulfide, that at right is type 64 unfilled Nylasint. Powder is squeezed together in punch and die, then sintered below melting point to supply wide range of parts having excellent wearing characteristics. (Photo, National Polymer Products)

*President, The Polymer Corp., Reading, Pa.
[1]Numbers in parentheses link to references at the end of article.

without failure than will injection molded nylon.

Comparative wear data obtained in tests at Franklin Institute on thrust rings of oil-sintered nylon and injection molded nylon rotated against hardened tool steel (hardness of 63-5 Rockwell C, with 1.5-microinch finish) at various speeds and loads are given in Table I. (Oil-sintered nylon parts are usually impregnated with oil to a degree depending on compacting pressures.)

The PV values in these tests were set much higher than those recommended for normal service in order to accelerate failure. The great differences in running time among the several tests ought not, therefore, to be considered representative of performance under normal service conditions. On the other hand, sintered nylon bearings have exhibited very long life at PV values up to 8000 p.s.i., ft./min. In these accelerated tests it is very difficult to distinguish true wear from compressive set[2] but it is obvious that the oil-sintered product will carry higher loads without excessive "chattering" and early failure than injection molded Zytel 101 nylon.[3]

A further very interesting advantage of the sintered product which as yet has had little recognition, but which may have considerable future technical importance, is its ability to be formed into porous nylon structures with interconnected pores. Such pieces can be impregnated with a suitable lubricating oil and operated as bearings with all the wear-resistant advantages of nylon but with a significantly lower coefficient of friction (even lower than the non-porous, oil-sintered material). Uses to date have been with bearings containing 10 to 20% by weight of oil. Because of its ability to retain oil, porous sintered nylon also shows promise for such applications as ball bearing retainer rings. In one textile application, oil-filled nylon is replacing filled Teflon sleeve bearings because of greater economy. Thorough impregnation of the porous pieces can be accomplished simply by immersing them in oil in a vessel that is first evacuated to draw the air from the pores, then pressurized to force the oil into them.

Present uses for sintered nylon parts are in business machines, automotive equipment, airplane instruments, and textile machinery. These parts consist largely of cams, slides, rollers, bearings, and other articles subjected to wear. Since injection molded nylon parts are often cheaper than sintered parts, the uses for the

(*To page* 163)

[2]Change in weight of the test piece is not a reliable indicator of wear since the sintered nylon pieces lose oil and pick up water during the test.

[3] Zytel is a registered trademark of E. I. du Pont de Nemours and Co.

Table I: Comparative wear and frictional data between sintered and injection molded nylon based on accelerated test

Material	*Type of lubrication*	*Load*	*Surface speed*	*Coefficient of friction & comments*	*Total wear*[a]	*Pressure-velocity product (PV)*[b]	*Power consumption (FV)*[c]	*Running time*
		p.s.i.	*ft./min.*		*mil*			*hr.*
66 Nylasint	Sintered in Gulf Crest 55 (no other lubrication)	135	240	0.12 Smooth, no change	1.5	32,400	3890	48
66 Nylasint	Sintered in Gulf Crest 55 (no other lubrication)	195	240	0.10 Smooth, no change	1.5	46,800	4680	24
66 Nylasint	Sintered in Gulf Crest 55 (no other lubrication)	195	370	0.09 Smooth, no change	1.5	72,200	6500	24
64M Nylasint	Sintered in Gulf Crest 55 (no other lubrication)	195	240	0.10 Smooth, no change	1.5	46,800	4680	24
101 Nylon Inj. molded	2 drops Gulf Crest 55	195	240	0.11 Smooth, no change	2.7	46,800	5150	21
101 Nylon Inj. molded	2 drops Gulf Crest 55	195	370	Very rough & variable running from 0.11 to 0.32	0.6	72,200	8000 to 23,000	Failed in ½ hr.
101 Nylon Inj. molded	None	29	240	Steady increase from 0.26 to 1.18. Rough during latter part of test	1.6	6,900	1800 to 8200	Failed in ½ hr.
101 Nylon Inj. molded	None	52	240	Steady increase from 0.19 to 0.67. Very rough	20.0	12,500	8370	Failed in 3 min.

[a]Wear based upon 24 hr. tests unless otherwise noted. Values include deformation of samples.

[b]PV = Load in p.s.i. × velocity in ft./min.

[c]FV = Frictional force in p.s.i. × velocity in ft./min.

The Sunbeam "Coffee Master" has parts made of two BAKELITE Phenolics—general-purpose BMG-5000 and chemical-resistant BMG-2095.

Phenolics

. . . too useful to be outmoded

You've seen phenolics around so long because they have so much to offer. These thrifty plastics thrive on new ideas, keep active on new jobs. One reason for this is their adaptability. They cover a wide range of needs. There are five different categories of BAKELITE Brand Phenolics, made up of dozens of compounds. Among them, you may well find the one with the ideal combination of properties for your product, whether it's well established or still in the planning stage. How long has it been since you looked at them? As a start, glance over the information on the next two pages.

The "Coffee Master's" phenolic rim is odorless, imparts no taste, and is unaffected by moisture or hot vapor. Chicago Molded Products Corp. used BMG-2095.

BMG-2095 . . . *a chemical-resistant phenolic*

This premium chemical-resistant molding material is also useful where moisture resistance, nontoxicity, and minimum odor are necessary.

It is a one-step, cellulose-filled phenolic with good molding latitude, fast set-up, and good mold release.

Dimensional stability is a notable property of BMG-2095. Surface appearance is excellent. Pieces molded from it will not bleed in most organic solvents. As a result, this material is useful for both industrial and consumer applications.

Handles, base, and switch for the Sunbeam "Coffee Master" were molded of BMG-5000 by Chicago Molded Products Corp.

BMG-5000 . . . *a general-purpose phenolic*

BMG-5000—the outstanding development in phenolics by Bakelite Company—is a truly general-purpose material, matching production efficiency with the broadest possible range of applications.

This means economy. BMG-5000, engineered for the best combination of curing speed and molding latitude, assures minimum down-time. It provides rapid set-up and easy release from mold cavity plungers and followers. Its lower specific gravity increases molded items per pound.

BMG-5000 is suitable for compression, plunger, or transfer molding. Products are rigid at hot discharge, can be released from the mold quickly and easily. An exceptional surface appearance results from the uniform shrinkage and absence of warpage and blisters.

TYPICAL PROPERTIES

Values relating to Fabrication	General-Purpose BMG-5000	Electrical-Resistant BMG-0750	Heat-Resistant BMG-8335	Impact-Resistant BMG-2080	Chemical-Resistant BMG-2095
Granulation (D392-38)	16 mesh	16 mesh	12 mesh	6 mesh	16 mesh
Bulk Factor (D392-38)	2.4	2.2	2.1	3.0	2.6
Plasticity Grades Available	4, 6, 9, 12, 15, 18	6, 9, 12, 15	6, 9, 12, 15	9, 12, 15, 18	4, 6, 9, 12, 15
Molding Shrinkage, in./in. (D955-51)	0.005	0.004	0.004	0.006	0.006
Values from Electrical Tests					
Dielectric Strength (D149-55T) Short time, volts/mil	370	385	150	280	225
Volume Resistivity, ohm-cm. (D257-54T)	1×10^{13}	1×10^{13}	5×10^{11}	1×10^{13}	1×10^{13}
	60 c. 1 kc. 1 mc.	60 c. 1 kc. 1 mc.	60 c. 1 kc. 1 mc.	60 c. 1 kc. 1 mc.	60 c. 1 kc. 1 mc.
Dielectric Constant (D150-54T)	5.7 5.3 4.6	4.9 4.7 4.5	20.0 13.0 8.0	11.0 8.0 6.0	22.0 13.0 7.0
Dissipation Factor (D150-54T)	0.07 0.04 0.03	0.020 0.018 0.008	0.25 0.20 0.08	0.21 0.16 0.05	0.30 0.25 0.06
Values from Mechanical Tests					
Izod Impact Strength (D256-54T) ft-lb/inch of notch	0.30	0.34	0.30	0.48	0.25
Compressive Strength (D695-54), psi	34,000	25,000	28,000	28,000	34,000
Tensile Strength (D651-48) (⅛ in.), psi	8400	7000	5000	7500	7000
Flexural Strength (D790-49T), psi	10,000	9500	7000	9000	7500
Modulus of Elasticity in Flexure (D790-49T), psi	10×10^5	22×10^5	12×10^5	8.5×10^5	8×10^5
Values from Miscellaneous Tests					
Molded Specific Gravity (D392-38)	1.34 Black 25 1.36 Brown 15	1.72	1.58	1.37	1.37
Heat Distortion Temp., deg. F. (D648-45T) (½ in—264 psi)	330	285	340	315	340
Moisture Sensitivity:					
Water Absorption (D570-54T), per cent wt. gain	0.45	0.03	0.2	0.4	0.4
Saturation Constant, per cent	8	1.1	3	4.8	3.5
Diffusion Constant, $cm^3/hr.$	1.3×10^{-5}	1×10^{-5}	1.5×10^{-5}	3×10^{-5}	7×10^{-5}

Bakelite Company has numerous phenolic compounds in other special categories as typified by:

BMG-0750 . . . *exceptional electrical resistance*

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Pieces molded from it have an exceptional gloss that is retained even after exposure to high temperatures. Color retention is also excellent. Consequently, BMG-8335 is widely used for utensil handles and heating appliance components. This mineral-filled two-step phenolic has a relatively low specific gravity. More items can be molded per pound. Finished pieces are compact and light-weight. In addition, they are resistant to wear and abrasion and are dimensionally stable.

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BMG-2080 . . . *high impact resistance*

While the impact resistance of this material is its primary feature, BMG-2080 balances this property with a number of others that are important.

Even at elevated temperatures, BMG-2080 displays superior resistance to moisture, soap, and detergents. It performs extremely well where one side of the molding is wet while the other remains dry. It is widely used for pump housings, valve bodies, fill tubes, aspirators, washing machine agitators, sterilizers, and dispensers. As a one-step material, BMG-2080 also offers several advantages in the molding process, notably minimum odor and a rapid rate of cure.

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Plasticizer Concentration, PHR	40	50	60
Durometer A Hardness	85	76	68
Elongation at 1000 psi	13%	36%	54%
Brittle Temperature	—14°C.	—22°C.	—28°C.
Loss from .004 inch film			
Volatile loss [24 Hrs. 70°C. (SPI)]	7.7%	9.0%	10.3%
Water Extraction (10 days at 23°C.)	0.1%	0.2%	0.4%
Oil Extraction (10 days at 23°C.)	4.5%	9.1%	14.1%

FLEXOL 426 is an all-purpose plasticizer. Profile extrusions, electrical insulation and jacketing, vinyl flooring, calendered sheeting, and plastisols are formulated with 426.

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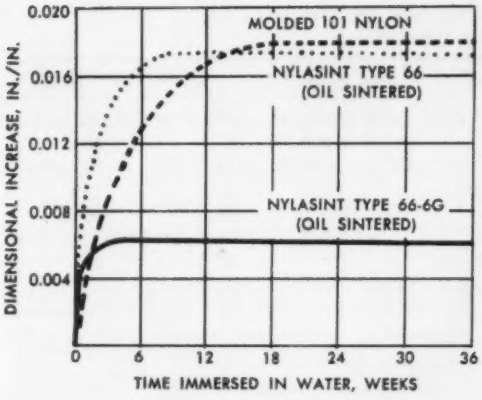


Fig. 2: Comparative dimensional growth due to moisture absorption of molded 101 nylon, oil-sintered Nylasint 66, and oil-sintered graphite-filled Nylasint 66-6G. Samples were bushings having dimensions: I.D. 0.5 in., O.D. 0.75 in., and length 0.75 in.

latter are in most cases found in applications where better dimensional stability or superior frictional or wear-resistant properties are required. The replacement of metal or laminated phenolic in various types of cams appears to be a particularly promising field.

Composition and moisture absorption

The precipitated nylon powders required for cold pressing and sintering are sold in the United States and Canada under the trademark Nylasint. Two unfilled powders are available commercially. Nylasint Type 66 powder has the higher rigidity, higher modulus of elasticity, and higher melting point, whereas Type 64 powder has higher impact strength and greater deformability. Both compositions are available with molybdenum disulfide additives (Nylasint Type 66M and Nylasint Type 64M) which further improve their frictional performance in some applications. Compositions containing various percentages of graphite are also available.

The advantages of a high percentage of filler in reducing hygroscopic growth in sintered nylon compared to the growth from moisture absorption in unfilled 101 nylon is shown in Fig. 2, above. Unfilled Nylasint 66 conventionally sintered in oil has about the same maximum dimensional growth due to water absorption as molded 101 nylon. The initial rate of moisture absorption of the sintered material is faster than that of molded nylon due to its porous nature. The type of sintering oil changes this rate and to some extent the final growth value. Pressed unfilled powder sintered in vacuum by laboratory techniques has an even faster growth rate due to moisture absorption but reaches about the same final level as a heavy-section molded product.

Nylasint powder has an ultimate particle size between 4 and 10 microns. Because the density of the powder is only one-eighth that of brass, it is necessary to agglomerate these particles to obtain good pourability. In addition, small amounts of additives are usually included for die-release lubrication and for further improvement in flow. A typical particle size analysis of the blended agglomerated particles is shown in Table II, below.

It is always desirable to machine prototype samples of sintered nylon for testing in specific applications. Small slugs or bars of sintered nylons in various diameters are available for this purpose. Sintered nylon can be readily machined without harming its inherent frictional properties and, in the case of the porous product, can be impregnated with oil either before or after machining as desired.

Table II: Typical size analysis of Nylasint type 66 powder

Screen size mesh	*Percent by weight*
+ 12	0.0
12 to 20	13.9
20 to 40	29.1
40 to 70	23.3
70 to 140	14.1
less than 140	19.6

Pressing and sintering

Sinterable nylon powders can be directly used as received after they have been tumbled in standard cone or twin-shell blenders for several minutes to assure uniform particle size distribution throughout the container. Careful attention must be given to keeping the powder dry. Containers must be closed tightly when not in use, as moisture is picked up rapidly from the air. While not as critical a problem as encountered by injection molders or extruders in guarding against moisture pick-up in 101 nylon molding powder, a change in moisture content of Nylasint powder results in a difference in molded density at the same molding pressure. Also, excessive moisture will cause cracks during sintering of heavy-section parts.

Conventional steel pressing dies of Rockwell C62-65 hardness can be used but allowance must be made for the greater shrinkage of nylon powders as compared with metal powders. It is generally desirable to have very little clearance (on the order of 0.0005 in.) between the plungers and cavities. Since nylon powders have higher fill ratios than most powdered metals, it is, of course, necessary to design the dies with extra length. Unlike plastic injection molding or compression dies, it is neither necessary nor desirable to use draft angles. Nylasint powders generally include a small amount of lubricant which facilitates ejection from the die.

Either mechanical or hydraulic presses such as those available from Haller, Kux, or Stokes may be used. These presses have some similarity to pelletizing presses used in the plastics industry, although generally they are more complex since both the upper and lower punches are free to move independently of each other. The choice of press depends upon the size and shape of the part being produced. Likewise, production

rates vary with the complexity of the part, but usually fall in the range of 350 to 1200 pieces per hour in a single-cavity die. Feeding devices should be designed to prevent excess shaking that may cause the very light nylon powders to become airborne (float), with attendant loss of fines. Bridging is seldom encountered except in filling deep cavities which have orifices less than 1/16 in. in diameter.

It is essential to sinter nylon powder under non-oxidizing conditions. Conventional gas ovens used for powdered metal parts are not suitable for this use, since they normally will not operate with sufficient accuracy of temperature control at the relatively low temperatures involved. The temperatures for sintering Nylasint powders must be very accurately controlled to obtain optimum results. Preferably, the cold-pressed briquettes are placed in a wire mesh container and immersed in an oil bath that is equipped with electrical heaters and stirrers. A very suitable heat transfer oil is Gulf Crest #55 obtainable from the Gulf Oil Co.

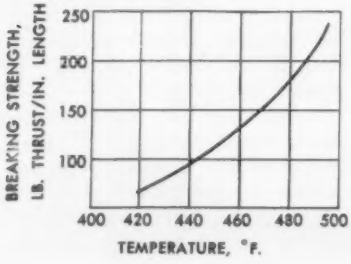
The recommended oil sintering cycle for Type 66 Nylasint powder is 30 min. at 495 ±2° F. with about 2 hr. to heat up to temperature and 2 hr. or longer to cool down to below 200° F. When sintering nylon powders of the Type 64 series, with cross-sectional thicknesses of approximately 1/8 in. or more, a longer cycle at lower temperatures must be used. For the Type 64 series, 2.5 hr. at 430 ±5° F. followed by 0.5 hr. at 445 ±2° F. is recommended, using approximately the same time to heat up and cool down as on the faster cycle above. The reason for the longer reduced temperature cycle is that blistering may occur when sintering Type 64 above 445° F. On thin sections of Type 64, however, a faster cycle at higher temperatures is possible.

Table III: Tentative standard specifications for Nylasint nylon powders type 66

Test	*Test Method*	*66*	*66MS*
Apparent density, g./cc.	ASTM D-392-38	0.27 ± 0.01	0.27 ± 0.01
Pourability, max., sec.	ASTM D-392-38	35	40
Fill ratio	ASTM D-392-38	4.0 ± 0.2	4.3 ± 0.2
Green molded density, g./cc.	[a]	1.08	1.16
Sintering temperature, °F.	[b]	495 ± 2	495 ± 2
Shrinkage, in./in.	[b]	0.025 ± 0.002	0.020 ± 0.002
Crushing strength, min., in./in.	[c]	300	300

[a]Test bearing specimen: 5/8 inch I.D., 1 inch O.D., 1 inch length. Green molded density is equal to the weight of an unsintered specimen divided by its volume when measured at least 20 minutes after pressing.
[b]Test specimen as in Note 1, pressed to the green molded density as indicated in the chart above. Shrinkage is the inside diameter of the die cavity less the outside diameter of the sintered part divided by the inside diameter of the die cavity.
[c]Test specimen as in Note 1. Specimen is placed between two parallel plates that are in contact with the cylindrical surface. No internal mandrel is used. When the force is applied, the specimen bends under the compressive load, failing in tension, usually along the intersections of its outside surface with the midplane parallel to the plates. Crushing strength is the compressive thrust in pounds per inch of length required to break the specimen.

Fig. 3: Crushing strength (see footnote "c," Table III, above) increases sharply as sintering temperature of pressed nylon powder (Type 66) is raised



Design limitations, tolerances

The design limitations of the process for making sintered nylon parts are similar to those of powdered metal parts. It is generally considered impossible to produce parts directly that have undercuts. Design engineers should keep in mind that parts are made by forces applied parallel to the bore of the die shell, and that parts must be able to be stripped from the die. The sample pieces of Fig. 1, p. 157, are representative of what can be made. In Reference 5 the subject of limitations in the design of sintered nylon pieces is discussed in detail.

Conventional cold coining procedures used to obtain improved dimensional accuracy with metal powders are not suitable for making Nylasint parts. In general, tolerances can be held at about the same limits as are possible by injection molding. The tolerances possible in pressed metal parts are not obtainable in sintered nylon and are not usually necessary because of nylon's greater resilience as compared with metal.

As a typical example, a sleeve bearing was required to meet the following specifications: I.D. between 0.297 and 0.303 in.; O.D. between 0.437 and 0.439 in.; length between 0.454 and 0.469 in. When production of these pieces was started, it was found by measuring many of them that the standard deviation of the O.D. dimension was 0.5 mil, while that of the length was 3 mils. These values illustrate the typical situation that dimensions perpendicular to the direction of punch travel are more easily controlled than those parallel to it. The tolerance range on the O.D. is about 4 standard deviations, so that about 95% of the production pieces will pass that specification. Since 15 mils, or about 5 standard deviations was allowed on the length, only 1.2% will be rejected by this specification. If somewhat more realistic specifications of 0.437/0.440 for O.D. and 0.454/0.471 on length had been given, over 99% of the pieces would have been acceptable.

In cases where there is difficulty in meeting specifications, and they have already been set as wide as is consistent with the performance desired, it may be possible to reduce dimensional variations by one of several general approaches: 1) better design of dies and punches; 2) closer control of feed metering, pressing force, and sintering temperature; 3) altering powder size distribution to get more uniform flow and packing; and 4) increasing the percentage of filler.

Physical properties

The strength of sintered nylon parts is a function of compacting pressure as well as sintering tem-

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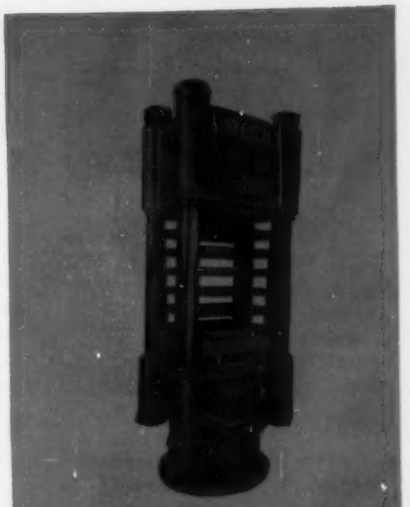

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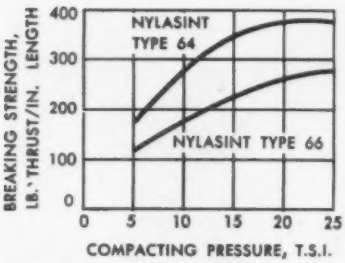

Fig. 4: Compacting pressure is an important factor in achieving high crushing strength in sintered nylons

peratures. The effect of temperature on breaking strength is shown in Fig. 3, p. 164. Increasing pressures up to approximately 20 to 25 t.s.i. gives increased strength, as shown by Fig. 4, above, which indicates transverse breaking loads on test bushings ½ in. I.D. by ¾ in. O.D. by ¾ in. long sintered at the temperatures mentioned above in the last paragraph on pressing and sintering. The porosity of such parts decreases as a function of pressure but tends to remain constant in the region above 20 to 25 t.s.i. The radial deflection before fracture under transverse loading of a test bushing ½ in. I.D., ¾ in. O.D. also increases with pressing pressure and nearly reaches a maximum at 25 t.s.i. High-strength parts should be pressed between 20 and 30 t.s.i to obtain a "green" molded density conforming to the specification values for Nylasint 66 shown in Table III, p. 164. Porous parts should be pressed between 10 and 15 t.s.i. In either case, the unsintered briquette is less fragile than most "green" metallic briquettes, so that no breakage is encountered if reasonable handling techniques are adopted.

Table IV, below, lists typical mechanical and electrical property data obtained from standard ASTM test specimens produced from Nylasint powders pressed at 25 t.s.i. It will be noted that very satisfactory strength values are obtained for a resinous material.

Also, deformation under load is less than that of injection molded nylon, indicating less tendency to "creep" in sintered parts. By the same token, however, there is less ductility in sintered pieces than in injection molded or extruded parts.

Sintered nylon is a very useful material if properly applied, but designers should recognize its limitations as well as its virtues. No one would consider using molded carbon where heavy shock loads are encountered and yet it is an important engineering product. Similarly, cast iron is a suitable frictional material in many applications but is not satisfactory where high impact is involved. Sintered nylon, although now much improved over the first material available, at the present state of the art is not as tough as injection molded nylon and therefore does not have the broad application possiblities of the latter material. Nevertheless, for frictional applications where lubrication is difficult, the sintered product does have the ability to operate at higher loads and speeds than injection molded nylon.

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1. U. S. Patents 2,695,425 and 2,698,966.

2. "Pressed and sintered nylon powder parts," by L. L. Stott and L. R. B. Hervey, Materials and Meth. *40*, 108, (Oct. 1952).

3. "Stability of nylon parts in business machines," by B. W. Nelson, SPE J. *13*, 13, (Feb. 1957).

4. U. S. Patents 2,592,616; 2,639,278; and 2,742,440.

5. "Sintered nylon plastics," by K. G. Harms, Product Eng. *25*, 150, (Nov. 1954).

Table IV: Typical physical and electrical properties for nylon parts

Test	*ASTM Test method*	*Nylasint type 66*	*66MS*	*64*	*64MS*	*Inj. molded 101 nylon*
Tensile strength at 73° F., p.s.i.	D648-44T	3500	2900	5400	5300	11,200
Elongation, %	D648-44T	nil	nil	nil	nil	90+
Compressive strength, p.s.i.	D695-54	15,700	11,500	20,800	19,800	10,000
Flexural strength, p.s.i.	D790-44T	6400	4600	7200	9900	13,800
Deflection in flex. strength test, in. at center	D790-44T	0.10	0.13	0.11	0.22	—
Deformation under load, 2000 p.s.i. at 122° F., %	D621-51	0.37	0.97	1.04	1.00	1.4
Impact strength, ft.-lb.	Special[a]	0.5	0.9	0.9	0.9	>10
Hardness, Durometer, D Scale	D676-55T	80	78	80	79	78
Specific gravity	D792-50	1.11	1.19	1.11	1.21	1.14
Dielectric constant at 10^6 cycles/sec.	D669-42	2.85	3.00	2.73	3.11	3.4
Dielectric loss at 10^6 cycles/sec.	D669-42	0.07	0.06	0.05	0.06	0.04
Dielectric strength, short-time, v./mil.	D149-55	380	480	370	448	385
Volume resistivity, 10^{12} ohm-cm.	D257-54T	7.3	8.7	16	6.4	4.5

[a] A ½ in. I.D. by ¾ in. O.D. by ¾ in. long bushing is placed on its side centered between a rigid bottom plate and a sliding top plate. Steel balls of increasing size are dropped from a height of 1 ft., measured from the bottom of the ball to the top of the upper plate, until the bushing breaks.

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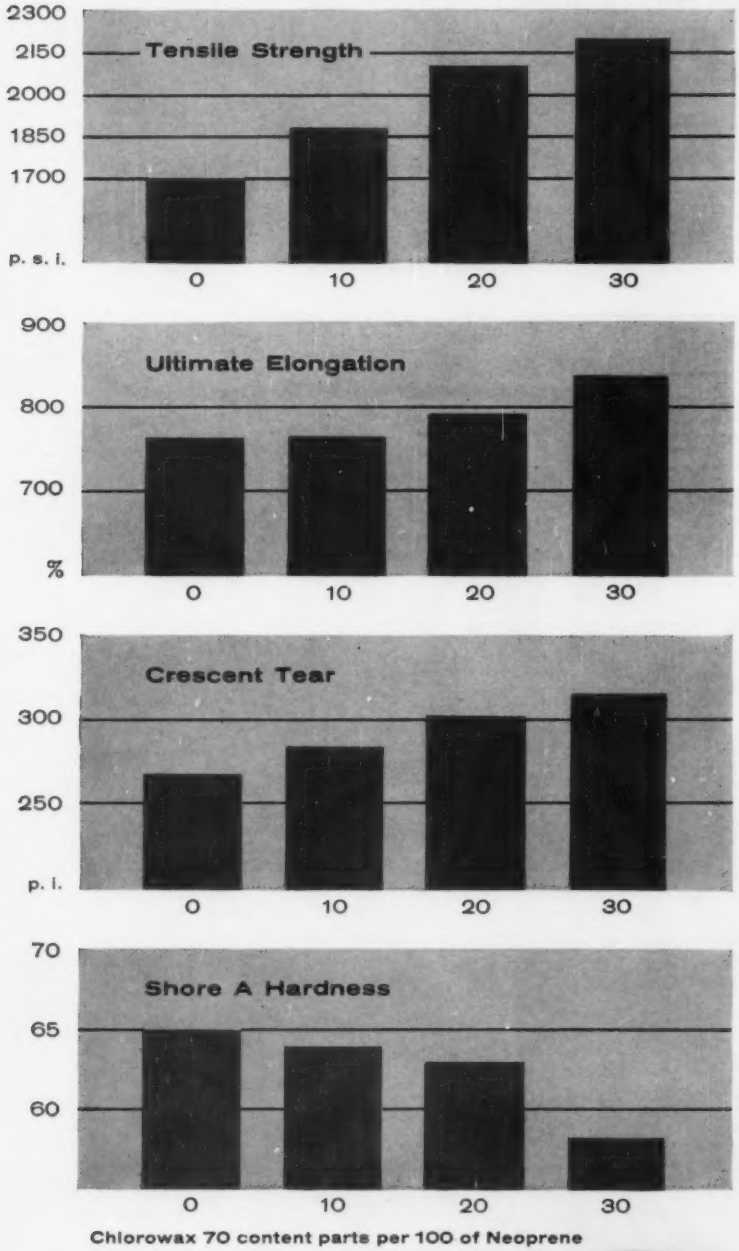

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NA-22	0.50
Super Multifex®*	100.00
Chlorowax 70	0, 10, 20, 30
Cure at 307°F., 15 minutes	

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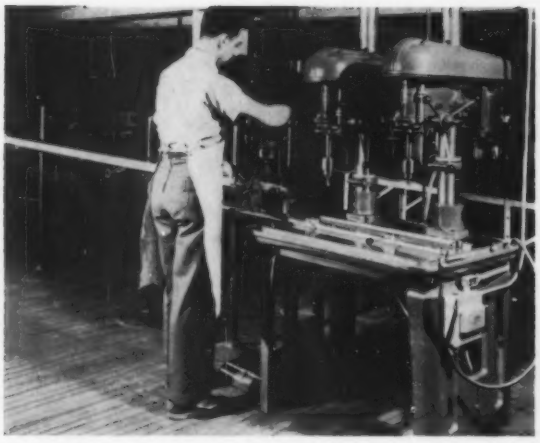


Fig. 1: Brass casting and phenolic tubing in camera tripod part are accurately drilled in one operation in this special indexing and locating fixture. Tolerances are held to 0.002 in., making the parts completely interchangeable. (Photos, Rockwell Mfg.)

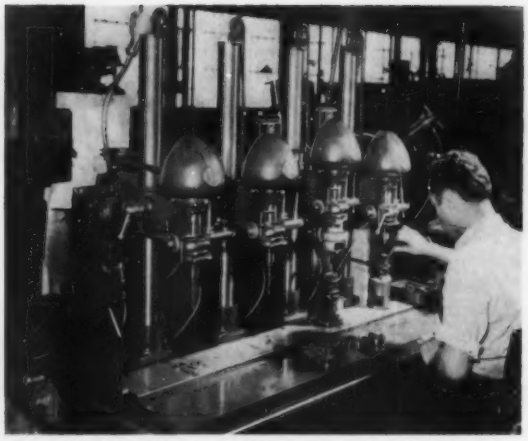


Fig. 2: Fixtures mounted on removable plate reduce set-up time to minimum on these four drill presses that perform successive operations on plastic parts for electrical switches. Fixtures are attached quickly and plate is positioned by clamps. On frequently run parts, fixtures are left on plate

Drill press is a versatile tool

Inexpensive attachments and production aids make it possible to do many machining and finishing jobs on plastics with a simple drill press

*By Ben Eldridge**

Many plastics machining operations conventionally performed on expensive, special-purpose metal-working machines can be done more economically by adapting standard drill presses to the work. A drill press, as a machine that provides a stable work surface, plus multiple speeds and up-and-down movement of the cutting tool, can be adapted to a great variety of machining jobs.

The accompanying pictures demonstrate the versatility of these inexpensive tools. With standard accessories or special jigs and fixtures devised for a particular job, drill presses can be used for grinding, polishing, milling, routing, shaping, and turning as well as for drilling and tapping. A drill press performs these operations at high production rates and usually with the same precision provided by special purpose machines.

The adaptability of drill presses also permits their use in short-run special operations. Since they are readily portable they may be moved from one department to another as production requirements change. Their portability, compactness, and ability to run

Fig. 3: Compound slide rest, made for use with lathe, and routing tool mounted in 14-in. drill press make efficient machine for milling thermoset model switch parts. Slide rest, bolted to drill table, permits adjustment and feeding in four directions

*Product Manager, Delta Power Tool Div., Rockwell Manufacturing Co.

Fig. 4: Drill press fitted with rotating table provides convenient method for grinding ends of molded plastic parts. Table is rotated at slow speed by series of three belts and pulleys from lower end of press motor. Grinding wheel is held in drill press spindle. Operator simply feeds pieces into countersunk holes in table and removes them after they have passed under grinding wheel

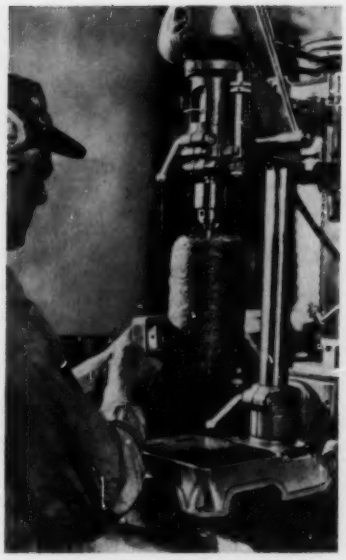


Fig. 5: Molded plastics parts can be finished and polished on 14-in. press. Steel wool is wrapped around mandrel held in press chuck and part to be cleaned is held against it as it revolves. Low cost of set-up makes it feasible throughout plant

when tilted also make it easy to use several presses together in assorted operations.

Drilling and tapping

The single-spindle drill press is the workhorse of low-cost drilling operations. Available in floor or bench models in sizes ranging from 14 in. to 20 in.—nominal size is twice the distance from spindle center to support column—it is often used freehand, or with simple box-type rollover fixtures or with templet fixtures. Rotary work tables, automatic spindle feed attachments, and air or hydraulic devices for positioning and holding the work (Fig. 1, opposite) make drill presses automatic or semi-automatic production line machines.

Two or more single-spindle drill presses are often used to perform two or more operations simultaneously. In drilling and countersinking a hole, for example, it is common practice to invert one drill head on a column under another. The top press drills as the bottom one, operated by foot pedal, countersinks a hole in the part positioned on the table between the two drill heads. Spindle stops are carefully set

(*To page* 266)

Fig. 6: Plug is spin-welded into nylon aerosol bottle simply by driving spinning plug into bottle neck, stopping press to allow fused surfaces to freeze together

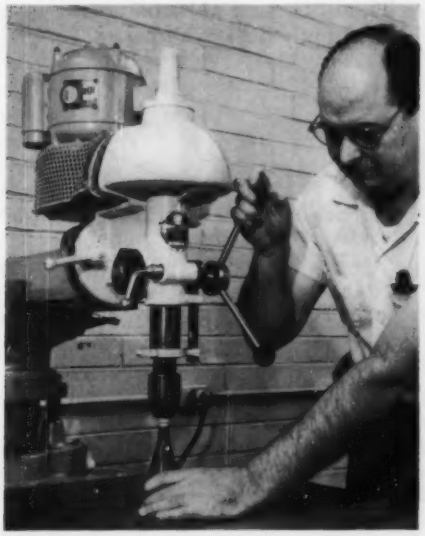
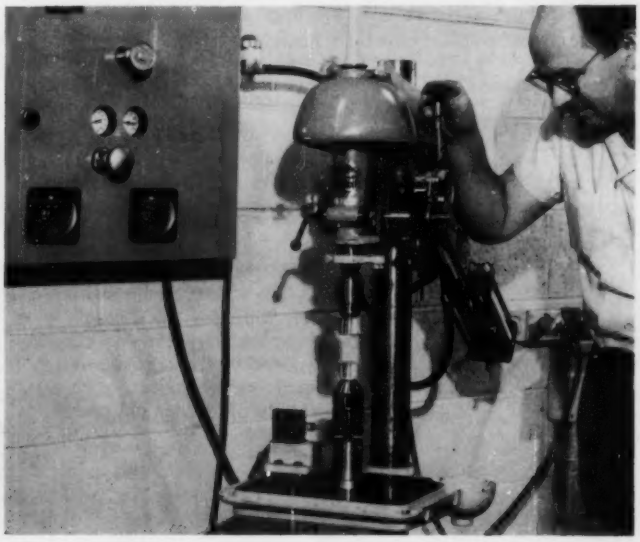


Fig. 7: In refinement of spin-welding technique, force is regulated by air cylinder, spinning interval is set on timer, and jig guarantees good alignment. Technique is not limited to bottles. Here two cylindrical blocks are to be welded together. (Photos, Du Pont)



"Trial Without Error" Is Achieved By Plastic Tooling With Marblette Resins

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Plastics Technical Section

Dr. Gordon M. Kline, Technical Editor

Role of radiation in graft and block copolymer synthesis

D. S. Ballantine†

While the amount of data on graft copolymers is as yet meager and scattered, the extent of interest is broad and increasing. A new field of copolymers is being opened up in which not only can the vinyl polymers be chemically combined into copolymer molecules of new shapes and properties, but also in which the condensation-type polymers can be joined to addition-type polymers to give a new family of copolymers. Examples of such new products are described in this paper.

Radiation gives promise of being a useful catalyst to the polymer chemist in effecting the synthesis of these new products. Much research lies ahead in the problem of controlling the undesirable homopolymerization which often occurs and in clarification of the grafting reaction kinetics and mechanism. A thorough physical, mechanical, and chemical characterization of the new copolymers has yet to be started and pilot plant operation of any high-volume radiation process has not been demonstrated. The question of the cost of radiation is a big unknown quantity but the graft copolymer reactions have an advantage over other radiation processes of vulcanization and cross-linking because of a lower radiation requirement.

Radiation from various sources has been studied in the past ten years by a number of polymer research groups in this country and in Europe. Radiation has been used as an initiation agent for vinyl polymerizations and in other instances for cross-linking or degrading polymers (1).[1] The application of radiation as an initiator has been limited to vinyl polymerizations and it has been demonstrated to have effect only in those reactions that involve free radical intermediates. Thus radiation has been used to polymerize styrene, methyl methacrylate, vinyl acetate, etc. in bulk, emulsion, or solution (2,3).

More interest has been focused on the effect of radiation on existing plastic materials. All plastics or polymers undergo changes when subjected to radiation, the direction and the extent of change depending on the chemical structure of the polymer, the degree of irradiation, and other experimental parameters. Some polymers have been cross-linked or vulcanized by radiation with notable improvements in certain physical and mechanical properties. The increase in melting point produced in polyethylene is perhaps the best example of this cross-linking reaction (4). Other polymers when irradiated undergo scissions in the backbone chain and degradation is the predominating reaction. Here again, the results are best interpreted by the assumption that the reaction proceeds via a free radical mechanism.

Therefore, as a result of this radiation research on polymer systems, one has established the necessary cornerstone on which to build graft and block copolymers. Radiation is capable of producing in a high polymer free radical sites and these free radical sites are capable of initiating vinyl polymerizations. When one, therefore, irradiates a polymer *A* in the presence of a vinyl monomer *B*, which is capable of free radical polymerization, a graft or block copolymer can be expected to result.

Whether a block or graft copolymer is formed will depend on the location of the radical site. If the radical has been formed by breaking one of the side chain bonds then a graft copolymer will be formed. If, however, a main chain rupture occurs leaving radical sites at the ends of the main chain fragment, a block copolymer should result. It is true though that the monomer *B* may also undergo a radiation-initiated homopolymerization which will

* Reg. U. S. Pat. Off.
† Fission Product Utilization, Brookhaven National Laboratory
[1] Numbers in parentheses link to references on p. 176.

contaminate the preferred A-B copolymer. The copolymerization process will be most efficient when the polymer used is very sensitive to radiation, (i.e., gives a large number of free radical sites), and the monomer exhibits a low rate of homopolymerization when exposed to radiation.

The present state of knowledge does not permit the classification of polymers and monomers into a rigid series of reactivities or efficiencies for the copolymerization process. However, from the existing data on radiation effects on polymers and known relative rates of polymerization of vinyl monomers with other free radical producing catalysts, some judicious inferences can be drawn. Table I, below, presents data on the radiation sensitivity of a number of monomers and polymers; these data are of value in predicting efficiency of the process for producing block or graft copolymers.

One would conclude from Table I that the most efficient process, one in which homopolymerization is minimized, would involve a combination of polymethyl methacrylate and ethylene. Conversely, the most inefficient combination would contain polystyrene and acrylic acid. Between these two extremes would fall all other cases.

Table I: Radiation sensitivity of polymers and monomers

Polymer	*Monomer*	*Decreasing sensitivity*
1. Polymethyl methacrylate	1. Acrylic acid	↓
2. Teflon	2. Vinyl acetate	
3. Cellulosics	3. Vinyl chloride	
4. Polyvinyl chloride and acetate	4. Methyl methacrylate	
5. Polyacrylonitrile	5. Acrylonitrile	
6. Polyesters	6. Styrene	
7. Polyethers	7. Butadiene	
8. Silicones	8. Ethylene	
9. Nylon		
10. Polyethylene		
11. Butadiene		
12. Styrene		

Experimental techniques

The techniques used can be made relatively simple and, as will be shown, by proper selection of technique the problem of homopolymerization can be almost completely eliminated.

The first technique is the most simple, and involves the immersion of a polymer *A* in monomer *B* and irradiation of the mixture for the desired period. It is not necessary that inhibitor be removed but the presence of inhibitor does result in the occurrence of an induction period. The liquid phase containing monomer may consist of pure monomer dissolved in a suitable solvent. It should be noted, however, that the solvent will affect the amount of homopolymerization depending upon the radiation sensitivity of the solvent relative to the monomer since radiation interaction with the solvent can produce free radicals capable of initiating polymerization. Insufficient data exist to state how the graft or block copolymerization process is affected by the solvent. There are as yet too many unanswered questions on the effect of tem-

Fig. 1: Reactions obtained with a polymer irradiation technique developed by Chapiro et al.

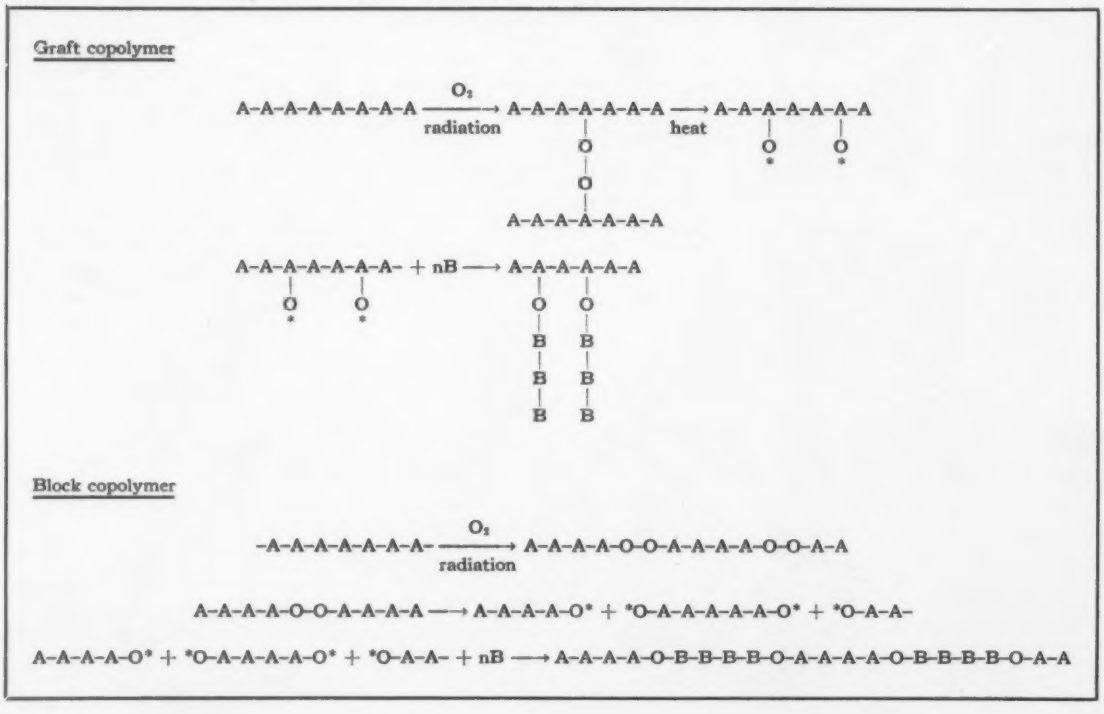

Table II: Graft and/or block copolymers produced by radiation using immersion technique

Polymer	Film thickness	Monomer	Radiation dose	Graft polymer
	mils		10^6 rads[a]	%[b]
Polyethylene	4	Styrene	0.67	16
Polyethylene	4	Styrene	1.34	26
Polyethylene	4	Acrylonitrile in DMF[c]	0.28	7
Polyethylene	4	Acrylonitrile	0.07	18
Polyethylene	4	Methyl methacrylate	0.02	21
Polyethylene	4	N-vinylpyridine	0.12	28
Polyethylene	4	Vinylcarbazone[d]	3.1	9
Polyethylene	4	Vinylstearate[e]	2.5	7.2
Teflon	1	Acrylonitrile	0.57	1.3
Teflon	1	Vinylacetate	0.21	2.2
Teflon	1	Styrene	1.6	4.9
Hevea rubber	N.D.[f]	Styrene	2.4	10.5
Hevea rubber	N.D.	Acrylonitrile[g]	0.56	50.
Dimethyl silicone rubber	N.D.	Acrylonitrile[h]	0.46	34
Mylar	N.D.	Styrene	12.2	8.8
Nylon[i]	N.D.	Styrene	28.	10.5
Polypropylene	N.D.	Styrene	3.1	43.4

[a] A rad is equivalent to the absorption of 100 ergs per gram of material. It is approximately equal to 1.2 roentgen or 1.15 rep which are other terms that have been used to describe the radiation dosage received.
[b] Percent graft polymer equals increase in weight divided by total final weight times 100.
[c] DMF = dimethylformamide
[d] 20% weight solution in toluene
[e] 60% weight solution in benzene
[f] N.D. = not determined
[g] Rubber swelled with monomer
[h] 20% weight solution in benzene
[i] Nylon cloth

Table III: Some properties of polyethylene-vinylcarbazole graft copolymers

Vinylcarbazole in graft copolymer[a]	Dosage	Dissipation factor, 1 kc. at 25° C.	Tensile strength	Elongation at break	Drape temp.
%	10^6 rads		p.s.i.	%	°C.
0	0	0.0006	2480	700	80-104
0	30	0.0006	3150	500	90-104
9.3	3.5	—	2660	660	98-112
16.7	1.36	0.0011	2360	505	—
25.9	2.04	0.0011	—	—	—
34.1	11.2	0.0012	2650	310	—
35.6	11.2	0.0012	2770	337	103-108
53.7	32.1	—	3600	45	165-220

[a] Calculated as weight of vinylcarbazole divided by total weight of graft copolymer times 100.

perature, radiation intensity, monomer concentration, the role of diffusion, etc., to postulate any mechanism for this reaction using the immersion technique.

Possibly a simpler technique involves the swelling of polymer with monomer and subsequent irradiation. Here, of course, the amount of grafting is limited by the extent to which the monomer in question will swell the polymer.

It has also been suggested that the reaction be studied in a homogeneous system where the polymer is dissolved in the monomer or where both polymer and monomer are dissolved in a common solvent. To date no work has been reported using this technique.

A technique that has many potential advantages over the foregoing uses the principle of pre-irradiation of the polymer species. After the polymer has been given a desired radiation exposure, it is immersed in inhibitor-free monomer and the copolymerization reaction proceeds. The radiation dosage required to give the same amount of copolymer is higher than in the immersion technique, but homopolymerization is virtually eliminated. It is believed that this pre-irradiation produces in the bulk polymer free radicals that are trapped and capable of long lifetimes. These lifetimes have been shown by paramagnetic resonance measurements and other chemical techniques to be in some cases periods of months (5). When these polymers containing free radical are subsequently immersed in monomers the copolymerization reaction occurs. The only homopolymerization that can occur is that deriving from radical transfer to monomer.

The role played by oxygen in this pre-irradiation technique is unsettled. Some investigators claim that the presence of oxygen is necessary for the reaction to occur. Contrariwise, work at Brookhaven National Laboratory, in which care was taken to remove oxygen from both polymer and monomer, showed that faster reactions occurred in the absence of oxygen. The cause of this discrepancy is not settled since some differences exist between the source of radiation, the intensity, and the experimental procedure employed by the various investigators.

Still another technique, somewhat different, has been employed by Chapiro and co-workers (6). This method involves the irradiation of polymer in the presence of oxygen and the formation of polymeric peroxides. The subsequent thermal decomposition of the peroxide linkage in the presence of a vinyl monomer produces free radicals capable of initiating vinyl polymerizations and the formation of block and graft copolymers. These reactions are illustrated in Fig. 1, opposite.

Systems investigated

An increasing number of polymer-monomer combinations have been investigated and data on some of the systems studied at Brookhaven National Laboratory are presented in Table II, above. The term grafting in this table is used generically since the product in some cases may be a block copolymer. After irradiation the

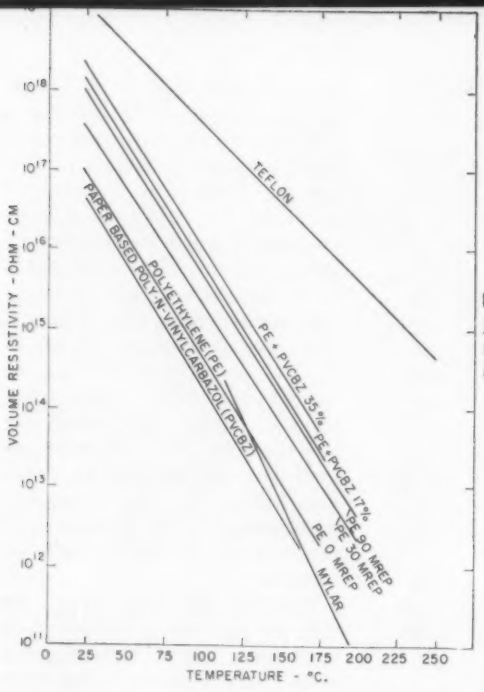

Fig. 2: Temperature dependence of volume resistivity for various dielectric films

product was exhaustively extracted with an appropriate solvent for the homopolymer that might have formed.

A number of interesting facts may be derived from the data in Table II. A comparison of the relative extent of reaction using the various monomers and the 4-mil polyethylene sheet clearly demonstrates that monomers like acrylonitrile and methyl methacrylate react much more readily than styrene. It is also obvious that the process can be made quite extensive in terms of the amount of monomer grafted. It is simple to produce copolymers containing 50% by weight of the added monomer, and Chapiro has added as much as 30 times the weight of the original polymer (6).

Noteworthy also is the very low amount of reaction observed in the case of Teflon and the various monomers. Since Teflon is a very radiation-sensitive polymer, it should be a very efficient source of radical sites capable of initiating reaction. The picture, however, is complicated by the fact that the Teflon shows little or no tendency to permit diffusion of the monomers below the surface layers and consequently only the surface layers are free to produce graft or block copolymers. Polyethylene, Hevea, and nylon allow greater diffusion and so the effect can be produced throughout the entire volume of the specimen. Work is in progress to determine the composition of the copolymer as a function of cross-section of the parent polymer to see if the effect is uniform throughout, merely a surface effect or whether there is produced a gradient from surface to the center of the specimen.

Probably the most significant feature of the data in Table II is the fact that new copolymers have been made possible. A wide variety of copolymers of ethylene have been shown to be capable of synthesis by this technique. The same is true of Teflon and Kel-F. The results on nylon and Mylar give promise of a field of copolymers between the polymers made by condensation mechanism and the polymers synthesized by vinyl-addition mechanism. Significant also is the relatively low radiation dosage required for this reaction. Previous application of radiation to cross-linking polyethylene and vulcanizing rubber has required dosages in the region of 20 to 50 million rads. The requirements for producing graft and block copolymers on the other hand is in many cases 1 or 2 million rads and in the most rapid cases can be as low as 0.05 to 0.10 million rads. Thus, not only are new copolymers made possible but also the amount of radiation is low enough to make possible practical processes.

Properties of copolymers

The properties possessed by these new graft and block copolymers are of equal if not even greater interest than the characteristics of the synthesis process. The interest is centered not only in the area of applications but also at the theoretical and research level. Historically, the polymer chemist has progressed from the homopolymers with their properties to linear copolymers in which he has achieved success in blending the properties of two homopolymers. He is beginning to understand the effect of branching and crystallinity and spatial disposition of substituent groups on the properties of homopolymers. There is room for considerable speculation on the comparison between properties of a linear copolymer of *A* and *B* species and graft copolymer in which the backbone is an *A* or *B*

Fig. 3: Surface grafting of 10-mil film, showing effect of grafted styrene on adhesion (Scotch Tape test, 12 in./min. parting rate)

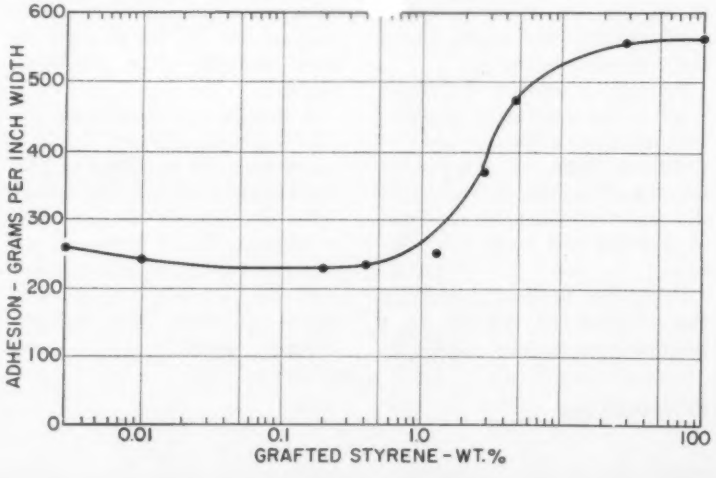

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Table IV: Effect of acrylonitrile on graft polymer on solvent resistance of polydimethylsiloxane[a]

Acrylonitrile in graft polymer	Dosage	Swelling index[b] at 20° C. in Toluene	Swelling index[b] at 20° C. in Heptane	Remarks
%	10^6 rads			
0	0	2.31	2.64	Elastic
0	0.4	2.33	2.62	Elastic
0	0.51	2.44	2.65	Elastic
3.1	0.1	2.45	2.59	Elastic
21.8	0.4	1.18	1.24	Viscoelastic
33.7	0.51	1.17	1.10	Viscoelastic

[a] Films of 10-mil thickness prepared from cast dispersion of DC-132 (polydimethylsiloxane plus $CaCO_3$ filler) and vulcanized with 2% benzoyl peroxide at 250° C. for 1 hr.
[b] Swelling index defined as ratio of swollen gel weight to dry gel weight.

chain and the branches are units of the other polymer or a block copolymer in which there are alternating long linear segments of *A* and *B* polymer. Specifically, the properties of a linear copolymer of vinyl chloride and vinyl acetate, and of a styrene-butadiene linear copolymer are well known. It would be of great interest and possibly of practical value to determine the properties of graft- or block-type copolymers made with the same monomers.

Since this field of block and graft copolymers is relatively new, there are few property data yet available. However, some tests have been made on a number of the graft copolymers produced by a radiation technique. Table III, p. 173, shows data on some of the physical properties of polyethylene-vinylcarbazole copolymers (7). The "drape temperature" in this table refers to the temperature range in which a film maintained at a 45° angle and heated at a constant rate in an air oven will bend under its own weight. The significant changes effected here are a reduction in the brittleness of polyvinylcarbazole and an increase in the softening temperature and insulation resistance of polyethylene. Fig. 2, p. 174 presents volume resistivity of several polyethylene vinylcarbazole graft copolymers over a temperature range of 25 to 175° C. and included also are literature data for polyethylene, cross-linked polyethylene, Teflon, polyvinylcarbazole, and Mylar (7).

The effect on adhesive properties of Teflon which is due to grafted styrene polymer is shown in Fig. 3. The grafted styrene has little effect below 1%, but between 1 and 10% the adhesive properties improve markedly and approach the values of pure styrene (7).

Table IV, above, shows some data on polydimethylsiloxane-acrylonitrile copolymers prepared in an attempt to increase the solvent resistance of the silicone rubbers. The solvent resistance as measured by simple equilibrium swelling measurements demonstrates that the grafted acrylonitrile produces a more solvent-resistant copolymer, but this is achieved at the expense of some of the desirable elastomeric properties of the original silicone polymer (7).

Possibly a more industrially interesting case involves a polyethylene-styrene graft copolymer which was further treated by sulfonation to yield a cation exchange membrane. Conventional cation exchange membranes are styrene-base polymers, which are very brittle, have little mechanical strength, and must be kept wet at all times. The polyethylene-styrene graft copolymer (containing a small amount of divinylbenzene) however, yields a tough, strong membrane which can be dried and which has at the same time a number of advantages over the existing membranes. Anion exchange membranes have been made also by grafting vinylpryidine to polyethylene followed by quaternization (7).

A recent paper described the preparation of graft copolymers of polystyrene-butadiene, polybutadiene-styrene by an emulsion transfer technique, and a comparison of these with conventional linear copolymer and mechanical mixtures of the two polymers (8). Preliminary data on this system are given in Table V, left. The authors further described the blending of the graft copolymers in the preparation of high-impact styrene resins with excellent combinations of properties.

The author is deeply grateful to Dr. D. J. Metz of Brookhaven National Laboratory for suggestions and discussions which helped greatly in the preparation of this paper.

Table V: Properties of copolymers of styrene and butadiene

Styrene	Butadiene	Type	Shore hardness	Tensile strength
%	%			p.s.i.
40	60	Linear copolymer	13	310
40	60	Styrene on polybutadiene	70	1240
40	60	Butadiene on polystyrene	64	1015
40	60	Blend of polymers	59	910

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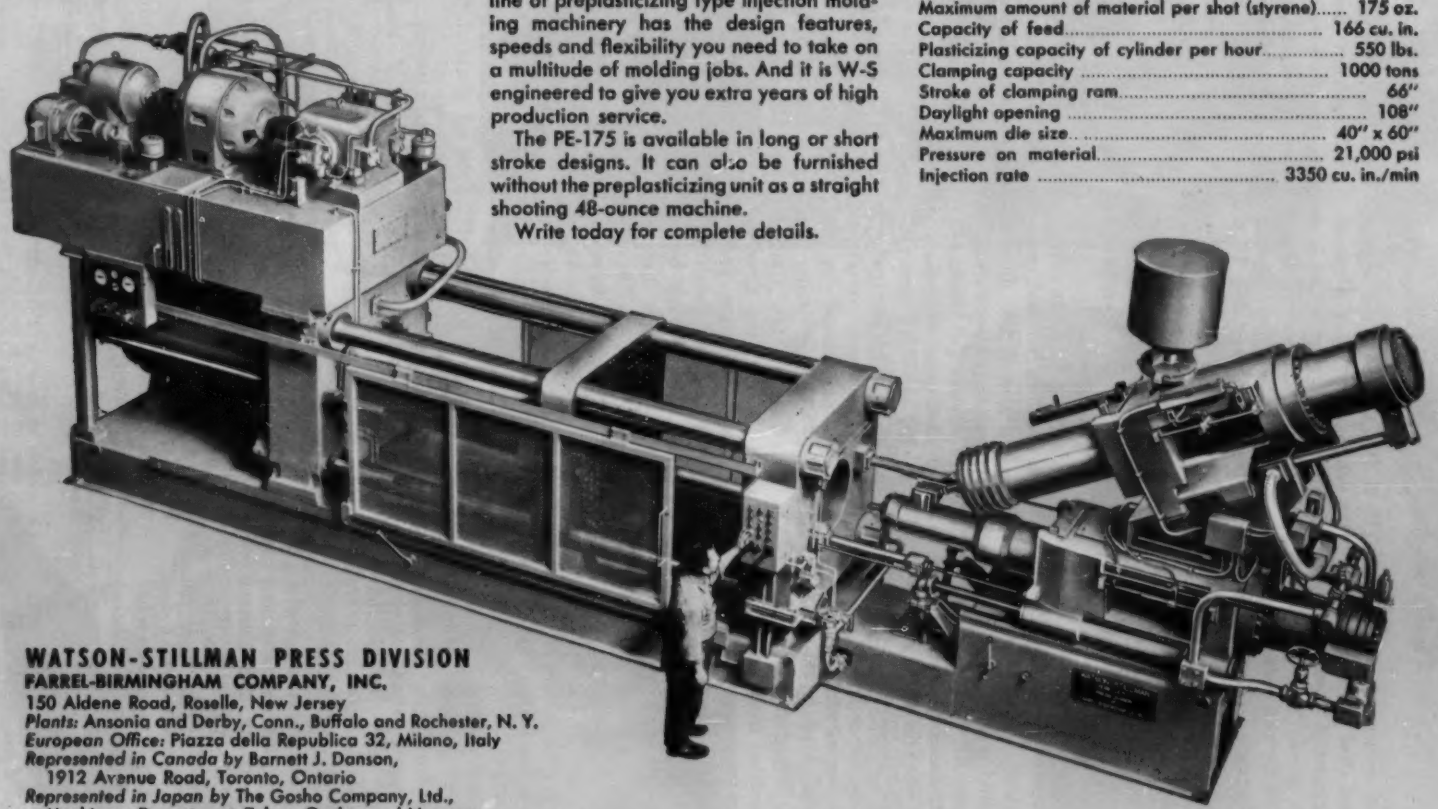

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WS-37

Silane finishes for fibrous glass

By M. H. Jellinek and N. D. Hanson†*

The past several years have seen a great deal of progress in the development of silane finishes for fibrous glass. This progress has been made, not only in the mechanical properties of glass-reinforced polyester resins, the original target of this work, but also in the fields of melamine, phenolic, and epoxy resins used for glass-reinforced plastics.

Several years ago, silane finishes, which were in use or being considered, included vinyltrichlorosilane, vinyl sodium silanolate, and a condensed vinyl silicone resin. All were extremely effective treatments and easily passed the wet and dry specification of the then-existing MIL Specifications for polyester resin laminates. Despite the good results which could be obtained, there were impedimenta to each of these finishing treatments. The chlorosilane treatment was highly corrosive to equipment then contemporary in glass-cloth treating plants. The vinyl silane finish was first offered as a solvent application and later as an emulsion application, but in either case a very high curing temperature of 530° F. was required. This was generally unavailable in curing furnaces. The sodium salt finishes deposited salt residues on the glass fabric during the finishing operation, necessitating careful handling to yield reproducible treatments.

The next stage in the development of commercially useful vinyl silane finishes involved vinyltriethoxysilane. This neutral silane ester, $CH_2=CHSi(OC_2H_5)_3$, was itself water insoluble. However, clever techniques were devised to get it into water solution. One solution was prepared by long stirring in acidic water (U. S. P. 2,688,006), and another was achieved by using a mixed-solvent system composed of 10 to 25% ethanol in water. Under these conditions, dry flexural strengths of approximately 70,000 p.s.i. could be obtained on polyester laminates, using standard laminating techniques with 181 fabric. Strength retention after boiling in water for 2 hr. held in the 90 to 100% range.

Considerable effort was devoted toward simplification and reduction in the cost of the finishing process. Another objective was to develop a process that would consistently yield good, reproducible results. An ancillary objective was to yield a more controllable process not sensitive to normal variations encountered in the glass-cloth finishing trade. The formulation of Union Carbide Silane A-172 and the development of its application process accomplished these ends. This vinyl silane ester is itself highly soluble in water and has no metallic ion content. The ease with which treating solutions can be prepared directly from this compound makes it attractive to the user. The use of water as the sole solvent contributes greatly to its effectiveness in overcoming the normal fluctuations in surface alkalinity observed with heat-cleaned glass fabric. In the heat-cleaning process some of the alkali content of the glass migrates to the surface. The amount is very small, but its location is critical to the subsequent application of finishes. The aqueous system used with A-172 effectively washes this surface so that reproducibility of finishes application is possible. The leached alkali is not in sufficient quantity to require any subsequent washing steps following cure of the finish. Commercial application of A-172 in glass-finishing plants is simple. It is carried out by diluting the treating silane with water to a concentration such that the glass picks up 0.9% of its own weight of the silane. At the time of preparation of the treating solution, enough sodium hydroxide is added to raise the pH to the range of 9.3 to 9.8. The heat-cleaned glass fabric is passed through this solution and directly into drying

Table I: Finish CM 26 A-172-finished glass cloth 181 tested in accordance with MIL-F-9118A specification

Test	*Spec. requires*	*Laminac*[a] *4202*	*Paraplex*[b] *P-43*	*Plaskon*[c] *941*	*Selectron*[d] *5003*
Ult. tensile strength					
Dry, p.s.i.	40,000	53,800	48,000	55,400	51,200
Wet, p.s.i.	38,000	53,600	49,500	56,700	53,500
Comp. strength edgewise					
Dry, p.s.i.	35,000	57,700	37,500	37,300	39,100
Wet, p.s.i.	30,000	54,600	39,500	41,900	37,300
Flexural strength					
Dry, p.s.i.	50,000	81,400	52,100	57,200	64,800
Wet, p.s.i.	45,000	78,000	54,600	60,600	63,000
Modulus of elasticity in flexure					
Dry, 10^6 p.s.i.	2.7	4.03	3.07	2.96	3.29
Wet, 10^6 p.s.i.	2.5	3.92	2.88	2.87	3.16

[a] A product of American Cyanamid Co.
[b] A product of Rohm & Haas Co.
[c] A product of Allied Chemical & Dye Corp.
[d] A product of Pittsburgh Plate Glass Co.

Presented at the Annual Meeting of the S.P.I. Reinforced Plastics Div., Chicago, Ill., Feb. 5-7, 1957.

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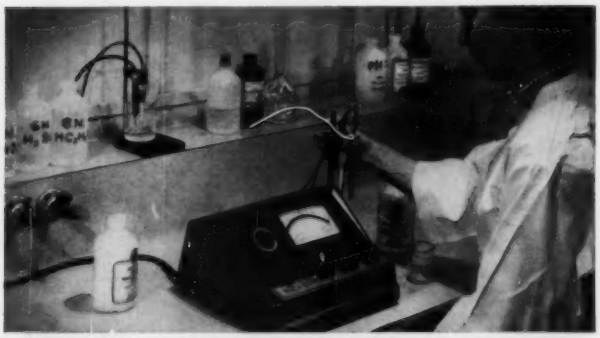

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ovens held at about 300° F. Under these conditions, 181 cloth can be finished at a minimum speed of 15 yd./min.

Polyester laminates

Commercial applications of A-172 in glass finishing plants were made, and the treated cloths, which contained the equivalent of approximately 0.9% A-172, were tested for compliance with MIL-F-9118A using a variety of accepted polyester resins. Table I, p. 178, reports the results obtained on one roll of 181 fabric and four different polyester resins. The tabulation gives the specification requirements as well as the average results obtained and certified by independent testing laboratories as part of the specification requirements for the Wright Air Development Center. These data and the panels on which they were obtained were submitted for qualification.

Phenolic laminates

The need for suitable silane finishes for other resin systems has been known for some years, but chemical technology had not advanced to the point that suitable reactive groupings could be introduced into the silane molecules in a practical manner. Some time ago we were able to make a silane ester having the organic section of the molecule containing an alkyl amino group. Union Carbide Silane A-1100 is based on this material and is gamma-aminopropyltriethoxysilane. It is water-soluble, salt-free, and the amino group provides its own alkaline catalyst for its hydrolysis and attachment to heat-cleaned glass fibers. Because of the propensity for phenolic resins to react with such amino groups, A-1100 was tried in conjunction with high-temperature phenolic resins to reduce the deleterious effects of 500° F. aging. Heat-cleaned glass cloth was finished with A-1100 by one of the commercial finishers and was impregnated with phenolic BLSA-3005[1] and BLL-3085[1] resins. Each of these resins was impregnated onto the A-1100-treated 181 fabric in accordance with the manufacturer's instructions and subsequently dried and rerolled. Laminates ⅛ in. thick were made in a steam-heated press at 100

[1]Resins marketed by Bakelite Co., Div. of Union Carbide Corp.

Table II: Lengthwise mechanical and physical properties of types I and II glass-fabric-base plastic laminates MIL-R-9299 made with 181 fabric finished with Union Carbide A-1100

Test Conditions	*Federal Specification L-P-406 test method number (exceptions noted)*	*Property*	*Specification requirements Class 1 or 2*	*Phenolic resin BLL-3085*	*Phenolic resin BLSA-3005*
Tested under standard conditions	1031	Flexural strength, flatwise Ultimate strength, p.s.i.	50,000	74,000	70,900
		Modulus of elasticity, 10^6 p.s.i	3.0	4.59	4.06
	1011 (Type II Specimens)	Ultimate tensile strength, p.s.i.	40,000	40,000	40,000
	1021	Ultimate edgewise compressive strength, p.s.i.	35,000	57,900	63,000
	2021	Flammability, in. per min.	1.0 (max.)	0	0
	7031	Water absorption, 24 hr. immersion, % change in wt.	+1.25 (max.)	0.53	0.31
	3.3.3.1.2	Barcol hardness	55	79.6	79.6
	5011 or 5012	Specific gravity	—	1.843	1.788
	7061	Resin content, %	—	34	36
Tested wet after immersion in water for 30 days	1031	Flexural strength, flat wise Ultimate strength, p.s.i.	45,000	67,600	71,100
		Modulus of elasticity, p.s.i.	2.5	3.57	3.86
	1011 Type II Specimens	Ultimate tensile strength, p.s.i.	38,000	42,000	41,900
	1021	Ultimate edgewise compressive strength, p.s.i.	30,000	51,700	56,700
Tested at 160°F. after exposure to 160°F. for ½ hr.	1031 and 4.2.3.1	Flexural strength flatwise Ultimate strength, p.s.i.	50,000	66,200	61,500
		Modulus of elasticity, 10^6 p.s.i.	3.0	3.5	3.7

(Table II continued on facing page)

Table II continued

Test Conditions	*Federal Specification L-P-406 test method number (exceptions noted)*	*Property*	*Specification requirements Class 1 or 2*	*Phenolic resin BLL-3085*	*Phenolic resin BLSA-3005*
Tested after 3 months outdoor weathering	1031 and 4.2.4	Ultimate strength, p.s.i.	50,000	62,000	74,000
		Modulus of elasticity, 10^6 p.s.i.	3.0	3.70	3.70
Tested after immersion in chemical fluids	4.2.5	MIL-O-5606,oil, hydraulic, aircraft petroleum base			
	7011	Change in weight (increase or decrease), %	2.0 (max.)	0.15	0.10
	7011	Change in thickness (increase or decrease), %	0.2 (max.)	0.16	0.13
	1031	Ultimate flexural strength, p.s.i.	45,000	73,900	68,800
	4.2.5	MIL-F-5566, fluid, anti-icing (isopropyl alcohol)			
	7011	Change in weight (increase or decrease), %	2.0 (max.)	0.21	0.08
	7011	Change in thickness (increase or decrease), %	0.1 (max.)	0.08	0
	1031	Ultimate flexural strength, p.s.i.	45,000	73,200	69,600
	4.2.5	MIL-E-5559, ethylene glycol, non-corrosive (anti-freeze-coolant)			
	7011	Change in weight (increase or decrease), %	2.0 (max.)	0.06	0.30
	7011	Change in thickness (increase or decrease), %	0.1 (max.)	0.06	0.10
	1031	Ultimate flexural strength, p.s.i.	45,000	74,000	69,700
	4.2.5	MIL-H-3136, hydrocarbon fluid, standard test, (Type III)			
	7011	Change in weight (increase or decrease)	2.0 (max.)	0.02	0.05
	7011	Change in thickness (increase or decrease)	0.2 (max.)	0	0.01
	1031	Ultimate flexural strength, p.s.i.	45,000	73,400	67,500
Tested at 500°F. after ½ hr. at 500°F.	1031 and 4.2.3.2	Flexural strength flatwise			
		Modulus of elasticity,	40,000	51,000	53,800
		Ultimate strength, p.s.i.			
		10^6 p.s.i.	3.0	3.13	3.58
	1021 and 4.2.3.2	Ultimate compressive strength, edgewise, p.s.i	30,000	34,000	52,500
	1011 (Type II Spec.) and 4.2.3.2	Ultimate tensile strength, p.s.i.	30,000	33,000	30,700
Tested at 500°F. after 100 hr. at 500°F.	1031 and 4.2.3.2	Flexural strength flatwise	*Class 1*	*Class 2*	
		Ultimate strength, p.s.i.	12,500	20,00	39,000	37,500
		Modulus of elasticity, 10^6 p.s.i.	2.0	2.5×10^6	3.0	3.0

Table III: Comparison of mechanical properties of laminates made with selected phenolic resins for high-temperature service on 181 fabric with A-1100 and previous best commercial finish

Property	Phenolic resin BLL-3085 — Previous best commercial finish	Phenolic resin BLL-3085 — UCC Silane A-1100	Phenolic resin BLSA-3005 — UCC Silane A-1100
Ultimate flexural strength, room temp., p.s.i	50,000	76,000	72,000
Ultimate flexural strength at 500°F. after ½ hr. at 500°F., p.s.i.	28,000	51,000	54,000
Ultimate flexural strength at 500°F. after 100 hr. at 500°F., p.s.i.	10,000	39,000	38,000
Ultimate tensile strength, room temp., p.s.i.	18,000	41,000	41,000
Ultimate tensile strength at 500°F. after ½ hr. at 500°F., p.s.i.	20,000	33,000	31,000
Ultimate tensile strength at 500°F. after 100 hr. at 500°F., p.s.i.	19,000	29,000	29,000
Ultimate compressive strength edgewise, room temp., p.s.i.	43,000	58,000	63,000
Ultimate compressive strength edgewise at 500°F. after ½ hr. at 500°F., p.s.i.	19,000	33,000	52,000
Ultimate compressive strength edgewise at 500°F. after 100 hr. at 500°F., p.s.i.	9,500	43,000	49,000

Table IV: Comparison of electrical properties of melamine laminates made from HG-28 cloth with heat-treated finish 111 and A-1100 finish

Property	Usually guaranteed by trade	Union Carbide A-1100
Dielectric strength parallel to lamination		
Dry, kv.	23	60
After 24 hr. in water at 50°C., kv.	5	50
Dielectric strength perpendicular to lamination		
Step by step, v./mil	160	300
Quick rise, v./mil	260	330
Water absorption, %	1.0	0.38
Power factor		
Dry	0.02	0.02
After 24 hr. in water	0.05	0.02
Insulation resistance,		
4 days at 35°C. and 90% R.H., megohms	100	20-40,000
Volume resistivity,		
4 days at 35°C. and 90% R.H., megohms	50,000	140,000
Surface resistivity,		
4 days at 35°C. and 90% R.H., megohms	160	400

Table V: Comparison of heat-cleaned vinyl silane (A-172) and amino silane (A-1100) finishes on 181 fabric with melamine resin

Glass Finish	Flexural strength — Dry	Flexural strength — Wet	Retention of strength when wet
	p.s.i.	p.s.i.	%
Heat-cleaned (finish 112)	26,000	9,000	33
A-172 (vinyl)	38,000	18,000	47
A-1100 (amino)	80,000-100,000	80,000-100,000	100

p.s.i., using stops. Following pressing, the laminates were removed from the press and were oven-postcured in the following cycle: 1) place in 325° F. oven, hold for 12 hr.; 2) over 3 to 4 hr., raise to 450° F. and hold for 2 hr.; 3) increase to 500° F. in 1 hr. and hold for 2 hours. Cool slowly to room temperature.

The laminates were tested in accordance with the qualification tests set down under specification MIL-R-9299 (USAF), "Resin, Phenolic, Low-Pressure Laminating." The results of these tests are presented in Table II.

The detailed comparison of these two resins on A-1100 treated glass-fabric 181 with MIL-R-9299 shows that the specification properties are readily surpassed. In order to demonstrate the large change in mechanical properties that A-1100 can bring out in a good resin by chemically bonding it to the glass, the data in Table III have been assembled. This tabulation compares selected mechanical properties of the two phenolic resins BLL-3085 and BLSA-3005 when used on the best commercial glass finish then available and glass finished with A-1100. These data are given to show the importance of the amino group in these silanes.

The large increase in room-temperature mechanical properties presented in Table III is believed due to the chemical bond the silane makes to the glass, coupled with the chemical bond the silane forms with the phenolic resin. By this means, the resin is chemically coupled to the glass via the chemical bridge supplied by the aminosilane. The great improvement in high-temperature properties is undoubtedly due to the elimination of the capillary air space between the phenolic resin and the glass fibers. By sealing these openings throughout a laminate, the large internal surface available to combustion is eliminated, and the rate and degree of deterioration is decreased markedly.

Melamine laminates

The basic chemistry of melamine resins is concerned with the cross-linking mechanism involv-

(*To page 274*)

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Heat distortion temperatures of epoxy resin-catalyst combinations

By A. H. Hoerner, M. Cohen*, and L. S. Kohn**

The excellent physical, chemical, and electrical properties of epoxy resins have attracted a large amount of interest during the past five years. These materials have been used successfully as finishes, molding and encapsulation compounds, binders for laminates, adhesives, and electrical insulation.

Upon their introduction, epoxy resins appeared to be highly promising for electrical insulation applications. It was soon noted, however, that although the physical and electrical properties were satisfactory at room temperature, they fell off markedly at approximately 100° C. These changes were reversible and the original properties returned upon cooling. Nevertheless, the changes accompanying increasing temperatures prevented use of the resins in a large number of potential electrical applications. The advent of new curing systems raised the temperature at which significant changes in properties were observed and epoxy resins have taken a place among the more useful electrical insulation materials. The results of an investigation of a number of these curing agents are summarized in this article.

One method to determine the high-temperature strength and thermal stability of a resin is the heat distortion test. The heat distortion temperature (ASTM D 648-55T) is defined as that temperature at which a cured stock of definite dimensions deforms exactly 10 mils under a definite fiber stress when immersed in an oil bath with a temperature rise of 2° C. per minute. The fiber stress may be either 66 or 264 p.s.i., depending on the nature of the material under test. All our data are based on a stress of 264 p.s.i. While this is an arbitrary value, it does help to differentiate among materials and provide an index of properties at elevated temperatures. To that end it is a very valuable measurement.

There were a number of items concerning heat distortion temperature of interest. Among these were the change of heat distortion point on aging, the correlation of heat distortion point with bond strength, heat aging life, and electrical properties, and variation in the heat distortion point with curing conditions. In addition, heat distortion data were assembled on commonly used epoxy resin systems.

*Wire and Cable Dept.; Medium Steam Turbine, Generator and Gear Dept.; and Large Steam Turbine, Generator Dept., respectively; General Electric Co.

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Experimental procedure

The heat distortion temperatures were measured in a Tinius Olsen heat distortion testing machine capable of testing five specimens at the same time. The samples were prepared as follows: Liquid curing agents and resins were mixed at room temperature or at 40° C. Higher-melting curing agents were melted into the resins at 60 to 130° C. Mixtures were left for a few minutes to allow the entrapped air to escape before they were poured into a mold.

The mold is made of three pieces of 8- by 11-in. steel. The outside pieces are ½ in. thick, while the center piece is ⅝ in. thick. The center piece contains six oversize cavities 7 by ⅝ by ⅝ in. to allow for shrinkage of the resin during cure. The assembly is held together by ¼-in. bolts distributed throughout the mold. Silicone grease insured release of the resin samples from the mold. After the mold was filled, it was placed in a large forced-air-circulation oven for the specified cure. In some cases the mold was preheated in the oven at the curing temperature in order to prevent crystallization of the catalyst before the resin could cure.

After curing, the mold was cooled to room temperature before removing the bars. They were then either machined to size, 5 by ½ by ½ in., or first aged and then machined.

Results

The experimental results are given in Table I, p. 186. Unless otherwise stated each mean determination is an average of three measurements. Except where noted, the range in experimental values of the given set of samples was within 1 or 2 degrees.

It should be noted that the times given for optimum cure will depend on the size of the sample (reaction exotherm) and factors such as the time for the mold to reach oven temperature, etc. One factor that arises in any investigation of properties of epoxy resins is the batch-to-batch variability in the product offered by the manufacturers. Such items as epoxide equivalent, hydroxide equivalent, chlorine content, and reactive diluent content could be among the variables. While some improvement has been made in quality control, considerable variability is occasionally encountered. These differences are especially important when resins

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Table I: Heat distortion temperatures of various epoxy resin-catalyst combinations after various curing treatments

Catalyst and resin[a]	Approximate pot life[b]	Mean heat distortion temperatures at 264 p.s.i. stress: 15 hr., 100°C.	15 hr., 100°C.; 15 hr., 150°C.	15 hr., 100°C.; 1 mo., 150°C.	15 hr., 100°C.; 2 mo., 150°C.	15 hr., 125°C.	15 hr., 125°C.; 1 wk., 150°C.	15 hr., 125°C.; 1 mo., 150°C.
		°C.	°C.	°C.	°C.	°C.	°C.	°C.
Triethanolamine (12 parts), Epon 828 (100 parts)	3-5 days at 25°C.	74 76	71			60 62	70	79
Triethanolamine (12 parts), Araldite 6020 (100 parts)	3-5 days at 25°C.	98 96	82	93		81 80	73[c]	
Triethanolamine (12 parts), Araldite 6020 (100 parts), aluminum oxide (40 parts)	3-5 days at 25°C.	100	87			84	76	
Piperidine (6 parts), Epon 828 (100 parts)	6-15 hr. at 25°C.	104 94	124[c]			85 89	97	98
Piperidine (6 parts), Araldite 6020 (100 parts)	6-15 hr. at 25°C.	103 105	120	117		116 117	119	
Shell catalyst CL (15 parts), Epon 828 (100 parts)	4-6 hr. at 25°C.	123 128	146[c] 150	162	173	143	159	
Shell catalyst CL (15 parts), Araldite 6020 (100 parts)	4-6 hr. at 25°C.	117 119	130 131	166	170	123	156	
		15 hr., 25°C. 15 hr., 80°C.	15 hr., 80°C.	15 hr., 80°C. 15 hr., 150°C.	15 hr., 25°C. 15 hr., 80°C. 15 hr., 150°C.	15 hr., 100°C.	15 hr., 100°C. 15 hr., 150°C.	
DMP-30 (6 parts),[e] Epon 828 (100 parts)	½ hr. at 25°C.		100	114				
DMP-30 (6 parts), Araldite 6020 (100 parts)	½ hr. at 25°C.	96			130			
Shell catalyst D (10.5 parts), Epon 828 (100 parts)	15 hr.					85	93	
Shell catalyst D (10.5 parts), Araldite 6020 (100 parts)	15 hr. at 25°C.					65	78	
Diethylenetriamine (8 parts), Epon 828 (100 parts)	1 hr. at 25°C.		88	119				
Diethylenetriamine (8 parts), Araldite 6020 (100 parts)	1 hr. at 25°C.	91[d]	91	115	117			

[a]Sources of supply of some of the various catalysts and fillers were:

Triethanolamine	— Union Carbide Corp.
Aluminum oxide, Gr. C-730	— Aluminum Corp. of America
Piperidine	— Eastman Kodak Co.
Diethylenetriamine	— Union Carbide Corp.
DMP-30	— Rohm and Haas Co.

[b]Data on pot life were taken from various technical bulletins or were kindly supplied by E. W. McGuiness, Thomson Laboratory, General Electric Co., Lynn, Mass.
[c]Experimental values had a range of 5 to 7° C.
[d]Only two values of heat distortion point were measured.
[e]Ten parts DMP-30 recommended by manufacturer.

(Table I continued on facing page)

are being used near the heat distortion temperature since considerable differences in heat distortion point have been noted from time to time. This batch-to-batch variability is often greater than average differences among comparable resins of the various manufacturers. Therefore, any comparison among resins must take this into account.

As we were primarily interested in materials that are liquid at or near room temperature, the bulk of our work was with low-molecular-weight epoxy resins.

Effects of catalysts

With the triethanolamine systems, we have the curious phenomenon of a lower heat distortion point at higher curing temperatures. In three cases the heat distortion point decreased on aging 1 wk. at 150° C. However, data available on one of these systems showed that the heat distortion point then increased on further aging at 150° C. Araldite[1] 6020 gives higher initial heat distortion points than does Epon[2] 828. Addition of filler increases the mean heat distortion point slightly.

Epon 828 and piperidine give higher heat distortion points after 15 hr. at 100° C. than after the same time at 125° C. With Araldite 6020, the heat distortion point after a cure at 125° C. is higher than the heat distortion point after a cure at 100° C. Both resin systems continue to stiffen on continued aging, as evidenced by an increase in the heat distortion point. Araldite 6020 gives higher heat distortion points with piperidine than does Epon 828.

The curing agent CL-systems require a cure of at least 15 hr. at 125° C. to attain reasonable heat distortion points. On aging at 150° C. the heat distortion points of both the Epon and Araldite systems continue to rise. Epon 828 cures faster than Araldite 6020. It is only after 1 wk. at 150° C. that both systems have comparable heat distortion points.

Araldite 6020 gives a higher heat distortion point with DMP 30[3] than does Epon 828. A cure at 150° C. is necessary for the maximum heat distortion point, although a 15-hr. cure at 80° C. is sufficient to yield reasonable heat distortion values.

Shell Catalyst D gives a higher heat distortion point with Epon 828 than with Araldite 6020. As in the other cases discussed above, the resins continue to cure or harden on exposure to 150° C.

The heat distortion points of the diethylenetriamine systems were raised on curing at elevated temperatures, even though the catalyst is commonly used for room temperature cures. In fact, castings prepared with this catalyst at room temperature were too brittle to be removed from the mold even after a period of 2 weeks. Although the system can be used at room temperature, a postcure at elevated temperatures improves properties considerably.

The anhydride systems are interesting. Higher values of the heat distortion point are obtained with Araldite 6020 and 45 parts phthalic anhydride than with 61 parts of anhydride; 61 parts of anhydride represent approximately 82% of the theoretical amount calculated as one mole anhydride per equivalent epoxide groups, while 45 parts represents only 61% of theory. The latter amount has been recommended for Araldite 6020. It has been reported (1)[4] that the use of 81% of the stoichiometric amount of phthalic anhydride with Epon 834 gives a cured resin with maximum thermal yield point (comparable to the heat distortion point). With other anhydrides, and the same resin, values for maximum thermal yield point ranged from 55 to 125 per cent. (2)

The BF_3-400-cured systems (Table II, p. 190) are extremely

(*To page* 190)

[1]Trademark, Ciba Plastics Div.
[2]Trademark, Shell Chemical Corp.
[3]Rohm and Haas Co.
[4]Numbers in parentheses link to references at end of article, p. 278.

Table I, continued

Catalyst and resin	*Approximate pot life*	*Mean heat distortion temperatures at 264 p.s.i. stress*				
		15 hr., 125°C.	*15 hr., 125°C. 15 hr., 150°C.*	*15 hr., 125°C. 1 wk. 150°C.*	*15 hr., 150°C.*	*15 hr., 150°C. 1 mo. 150°C.*
		°C.	°C.	°C.	°C.	°C.
Phthalic anhydride (61 parts), Araldite 6020 (100 parts)	3 hr. at 130°C.	64		113		
Phthalic anhydride (45 parts), Epon 828 (100 parts)	3 hr. at 130°C.	36		114	95	133
Phthalic anhydride (45 parts), Araldite 6020 (100 parts)	3 hr. at 130°C.	74 71[4]		129	105	128
Phthalic anhydride (30 parts), Araldite 6020 (100 parts)	3 hr. at 130°C.		104			

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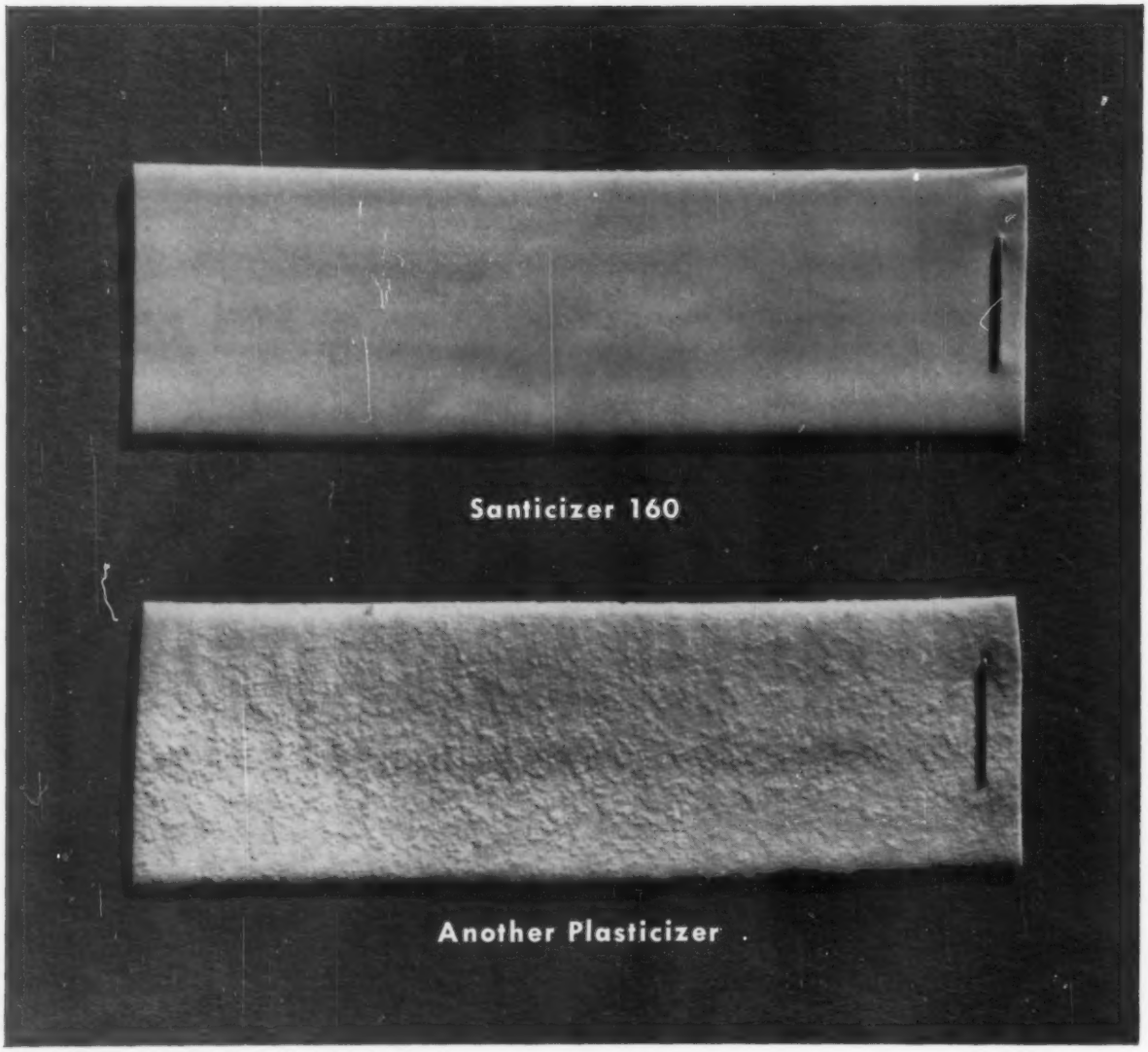

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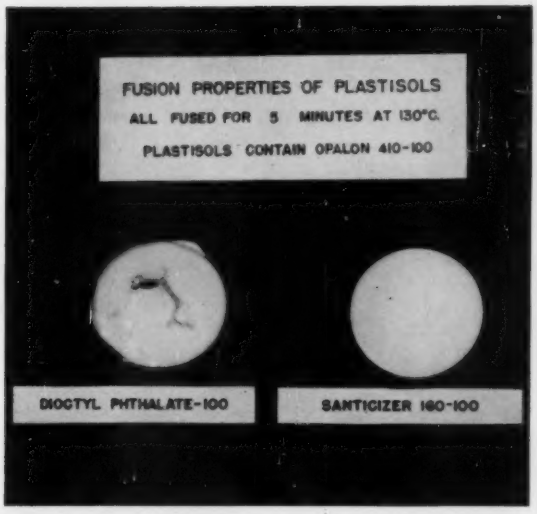

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interesting in that they offer rapid cure at moderate temperatures combined with long pot life at room temperature. The heat distortion points for the BF_3-400-cured Araldite 6020 fall off gradually on heat aging at 160 and 200° C. Araldite 6010 cured with 4.5 parts BF_3-400 follows the same general pattern when aged at 160° C. An entirely different picture presents itself, however, when Araldite 6010 is cured with only 3 parts BF_3-400 per 100. Here the cure progresses slowly but steadily until the unusually high heat distortion point of over 200° C. is reached.

Table II: Effect of heat aging on the heat distortion temperature of BF_3-400-cured resins[a]

	Heat distortion temperature for Araldite 6020 cured with			
	3.0 p.p.h. BF_3-400		*4.5 p.p.h. BF_3-400*	
Days	*160° C.*	*200° C.*	*160° C.*	*200° C.*
	°C.	°C.	°C.	°C.
0[b]	146.6	146.6	154.5	154.6
5	—	128.4	—	121.1
8	148.2	—	142.4	—
13	—	115.8	—	103.3
21	137	105.1	133	93
32	—	—	133	71
50	—	—	126.9	—
68	—	—	128.0	—

	Heat distortion temperature for Araldite 6020 cured with	
Days at 160° C.	*3 p.p.h. BF_3-400*	*4.5 p.p.h. BF_3-400*
0[b]	102.6	167.6
1	143.8	—
2	152.0	176.6
3	178.6	—
6	194.3	—
9	195.1	—
10	—	166.3
20	—	160.5
21	203.7	—
37	—	157.4
52	184.7	—
61	—	143.0

[a]Curing Agent BF_3-400—Shell Chemical Corp., New York, N. Y.
[b]All zero point data are for material cured 20 hr. at 150° C.; further heat aging is for days shown at temperature listed.

Table III: Increased heat distortion temperatures obtained with X-131

Composition[a]	*Cure*	*H.D.T.*	*H.D.T. normal*[b]
		°C.	°C.
X-131 — 50 parts Epon 828 — 50 parts Catalyst Z — 20 parts	20 hr. at 135° C.	160.6	138.7[c]
X-131 — 50 parts Epon 828 — 50 parts Epocast 16B —100 parts (an acid anhydride)	20 hr. at 135° C.	90.6	66.6[c]
X-131 — 50 parts Araldite 6010— 50 parts BF_3-400 — 4.5 parts	20 hr. at 135° C.	184	167.6[d]

[a]Sources of supply—
X-131 —Shell Chemical Corp.
Epocast 16B—Furane Plastics Co.
[b]That is, with 100 parts standard resin and no X-131.
[c]Cured 20 hr. at 135° C.
[d]Cured 20 hr. at 150° C.

Progress is not static in the development of new epoxy curing systems. For instance, Shell Development Co.'s experimental product X-131 appreciably increases the heat distortion points of standard formulations. X-131 with approximately 3.2 epoxy groups per molecule introduces a higher degree of cross-linking into the cured product than is obtained with conventional resins. Table III gives a few examples of the increased heat distortion temperatures obtained when X-131 is substituted for half the resin normally used.

An exact comparison of the heat distortion temperatures of the various catalyst systems is complicated by such factors as the cure cycle, change in heat distortion point with heat aging, and lack of very extensive heat-aging data on the above-mentioned systems. The batch-to-batch variations have been discussed previously. No attempt was made to investigate all the possible catalyst concentrations. In general, we used concentrations recommended by the manufacturer.

Significance of H. D. T.

The significance of the heat distortion temperature deserves some comment. In selection of a particular catalyst system, the heat distortion temperature is an important factor, but this criterion must be applied cautiously. The measurement of the heat distortion temperature is a specific one, i.e., the temperature, rising at a rate of 2° C. per minute, at which the resin is distorted 10 mils under a fiber stress at 264 p.s.i. The heat distortion temperature gives no information on the rate of deflection at temperatures near the heat distortion point nor on changes in properties above the heat distortion point. Further, it gives no information on the effects of higher loading.

The heat distortion points of epoxy resin systems may be used as guides to the range of temperatures over which various physical and electrical properties may be expected to remain constant or change very little. At

(*To page 277*)

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Plastics Digest*

Abstracts from the world's literature of interest to those who make or use plastics or plastics products. For complete articles, send requests direct to publishers. List of addresses is at the end of Plastics Digest.

General

Recent developments in factorial experimentation. W. J. Youden. Ind. Eng. Chem. *49*, 73A-74A (June 1957). Reinforced plastics are used to illustrate recent developments in factorial experimentation to reduce the amount of work.

The photoelastic properties of cross-linked amorphous polymers. Part 3. Interpretation of results on polythene, polymethylene, natural rubber, and gutta percha. D. W. Saunders. Trans. Faraday Soc. *53*, 860-70 (June 1957). The values for the optical anisotropies of the equivalent random links of the polymethylene, natural rubber, and gutta percha chains obtained from photoelastic measurements are compared with the values of the optical anisotropies of the relevant monomeric units obtained by calculation from values of bond polarizability ellipsoids given in the literature. The quantity q so obtained is regarded as an indication of the stiffness (or flexibility) of the polymer chains and has values ca. 48, 2.2, and 5.0 monomeric units per equivalent random link respectively for the polymethylene, natural rubber, and gutta percha chains. The detailed significance of q as an index of chain stiffness and its relation to the ratio of the number of links in the polymer chain to the number of links in the "statistically equivalent" random chain are discussed.

Materials

Effect of fillers in polyethylene. W. J. Frissell. Plastics Tech. *2*, 723-29 (Nov. 1956). A study was made of the effects of 26 different fillers on the properties of a medium molecular weight polyethylene resin. The fillers varied widely in the degree to which they changed such properties as tensile strength, yield strength, modulus of elasticity, brittle temperature, heat distortion temperature, and light stability. One of the fibrous glass samples caused the largest increases in yield strength and modulus. Asbestos shorts gave the greatest improvement in long-term strength. The least effect on all properties was found with either aluminum hydrate or Atomite wet-ground calcium carbonate. The results indicate that the addition of fillers to polyethylene may be used to broaden the applications of this already versatile resin.

Property-structure relationships in polyethylene. G. N. B. Burch, G. B. Feild, F. H. McTigue, and H. M. Spurlin. SPE J. *13*, 34-37 (May 1957). It is possible to prepare nearly linear polymers by modification of the basic Ziegler process. Some modifications lead to products of high linearity and narrow distribution of molecular weight. Other modifications produce less linear polymers, with possibly an increase in internal unsaturation. This trend can be still further increased by copolymerization. Narrow distribution and branching both lead to lower crystallinity and hardness in molded objects. The linear products of narrow distribution recrystallize, with resultant increase in modulus, when subjected to high loads or high temperatures. The less linear products do not exhibit this behavior to the same extent. It may be anticipated that three types of product will find wide fields of use. These are 1) high linearity, narrow distribution, for uses requiring good impact resistance and extensibility in the as-molded condition, combined with good retention of properties at high temperature; 2) high linearity, wide distribution, for uses requiring hardness and high modulus in the as-molded condition; and 3) less linear products, for applications demanding flexibility and low modulus. It is recognized, however, that these are but preliminary observations, and that only extended field use will determine types of products best suited for different applications.

Molding and fabricating

Extrusion of Teflon 6 tetrafluoroethylene resin for wire insulation. D. N. DeYoung and G. R. Snelling. Wire & Wire Prod. *32*, 644, 646-51, 713 (June 1957). A study of Teflon 6 paste extrusion for insulating wire was undertaken to determine the effect of each of the operating variables on the quality of the wire insulation. The die design, guide tip clearance, and oven temperature were found to be the most critical variables.

You'll save with plastic tools. O. F. Bernardin. Factory Management & Maintenance *115*, 110-12 (Apr. 1957). Production of tools made from epoxy resins by an eight-man team of specialists is described. These tools are usually used for small lot jobs (200 pieces or fewer) in the manufacture of critical aircraft components. They offer the following advantages: economy in fabrication, light weight, easy handling, quick design changes, low-cost duplication, and stability.

Applications

Proposed specification for plastic teeth. W. T. Sweeney, R. L. Myerson, E. E. Rose, and J. O. Semmelman. J. Prosthetic Dentistry *7*, 420-24 (May 1957). A specification suggested as the basis for evaluating plastic teeth for the dental profession is proposed.

Research progress in dielectrics—1956. A. E. Javitz. Elec. Mfg. *58*, 94-103 (Nov. 1956). The roundtable discussions and the formal reports presented at the Confer-

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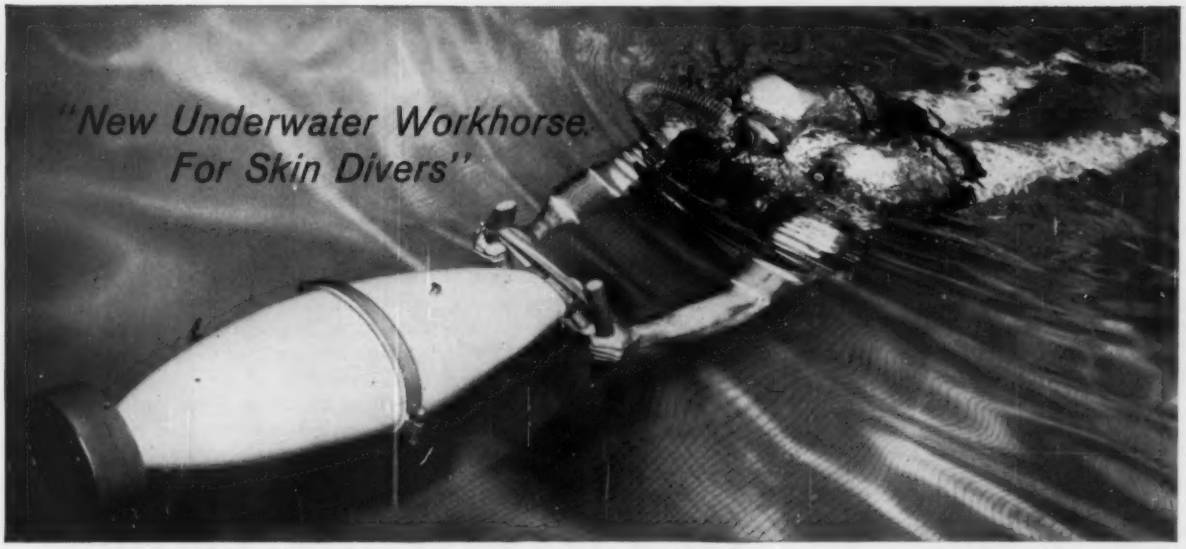

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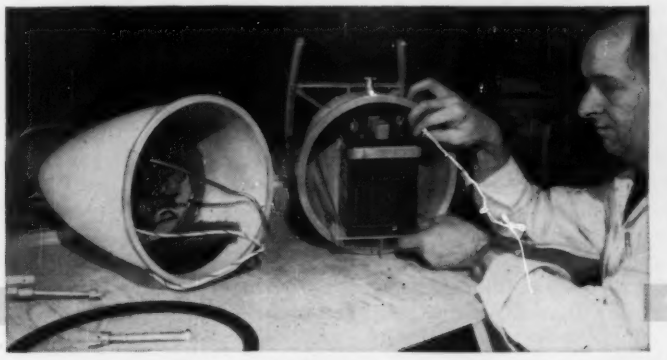

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ence on Electrical Insulation, Div. of Engineering and Industrial Research, National Research Council, are reviewed and interpreted. New materials described include solventless silicones for void-free impregnation and glass-reinforcing materials in the form of flakes rather than fibers. Other papers deal with the fundamental properties and the causes of breakdown of solid, liquid, and gaseous dielectrics. Round-table discussions generated high interest in new wire enamels, in the very high temperature materials (500°C. and above), and in the nuclear-radiation-resistant materials.

What's happening in plastics? Plumbing & Heating Business, 85-100 (May 1957). A thorough and detailed report is given on the applications, status of standards, types (with advantages and disadvantages of each), joining methods, codes, problems, and recent test results for plastic pipe.

Strength properties of plywood. Part 3. The influence of the adhesive. W. T. Curry. (Gt. Brit. D.S.I.R.) Forest Products Research Bulletin no. 39, 1957. 27 pp. Tests on five constructions of plywood made from gaboon veneers ranging in thickness from 1/10 in. to 1/20 in. and bonded with three types of adhesive (a liquid phenolic resin, a urea resin, and an animal glue) show that the presence of the adhesive modifies the structure of plywood in two ways. First, the wood close to the glue line is compressed, and second, the cavities in the wood are impregnated by the adhesive. The amount of compression and the thickness of the impregnated layers, although virtually independent of the veneer thickness, vary considerably with the type of adhesive. Of the three adhesives examined, the greatest changes to the structure occur with the phenolic resin and the least with the animal glue. The structural changes are also found to be accompanied by changes in strength, the phenolic-bonded plywood developing the highest stresses. As regards both the structural changes and the changes in strength, urea-bonded plywood is in general affected to a degree intermediate between phenolic- and animal-glue-bonded plywoods. From a comparison of test results and strength values calculated using the equations developed for structural plywoods, it is found that the equations lead to considerable error when applied to plywoods made from veneers less than 1/20 in. thick. The results of the strength tests indicate that phenolic-bonded plywoods are stronger than those bonded with urea resin and stronger still than plywood bonded with animal glue.

Coatings

Plastics-based strippable coatings. E. S. Lower and S. Cressey. Corrosion Technology *4*, 83-85 (Mar. 1957). The incorporation of corrosion inhibitors in various plastics-based strippable coatings to prevent rusting of metals is reviewed.

Plastics and the corrosion of iron and steel. G. A. Curson. Corrosion Technology *4*, 79-82 (Mar. 1957). Metal articles may be coated with plastics to prevent corrosion and to improve their appearance. Dipping and stoving, flame-spraying, emulsion-spraying, and an oven technique are discussed as methods of application of the coatings. The materials considered are the epoxy resins, nylon, Thiokol, and shellac.

Properties

Kinetics of crystallization in polyester. M. Takayanagi. Memoirs, Faculty of Engineering, Kyushu Univ. *16*, 111-49 (Jan. 1957). The size of spherulites in polyamide plastics may be controlled by the conditions of crystallization. Measurements of the spherulite growth of poly (ethylene adipate) under the microscope show that the temperature dependence of the linear growth rate of spherulites exhibits maximum value at a given temperature below the melting point, as does the generation rate of the spherulite nuclei. Crystallization rate and spherulite growth rate of various fractionated and unfractionated samples of poly (ethylene adipate) were measured at various temperatures and the spherulite nucleation rate for each crystallization temperature was evaluated. The effects of fractionation on the crystallization rate are discussed.

Wettability and friction of polytetrafluoroethylene film: effect of prebonding treatments. A. J. G. Allan. J. Polymer Sci. *24*, 461-66 (May 1957). The wettability of polytetrafluoroethylene film surfaces was studied by observing the equilibrium advancing contact angle formed by a drop of liquid on the surface. The surface treatment required to give good adhesion to various substrates produces a marked increase in the polarity of the surface as measured by the contact angles with a series of solutions of ethyl alcohol in water. Measurement of the coefficient of kinetic friction shows that the untreated side of treated material has the same coefficient as completely untreated film, but the treated side has a considerably higher friction. This higher friction of the treated surfaces is ascribed to the shearing of junctions in the bulk rather than shearing at the interface.

Permeability to liquids of polyethylene and irradiated polyethylene. H. A. Bent. J. Polymer Sci. *24*, 387-400 (May 1957). Permeability constants at four temperatures for twelve organic solvents of three polyethylenes and one electron-irradiated polyethylene are reported, together with some swelling data, and compared with data on nitrogen, oxygen, carbon dioxide, and methyl bromide. The organic solvents are acetic acid, methyl alcohol, *n*-propyl alcohol, aniline, benzaldehyde, methyl ethyl ketone, ethyl acetate, amyl acetate, dibutyl ether, *n*-heptane, benzene, and *o*-xylene. Irradiation appears to increase permeability and solubility coefficients for large penetrants at low temperatures, decreases the permeability coefficients of small penetrants at all temperatures, has little effect on the solubility coefficients of small penetrants, and tends to decrease both permeability and solubility coefficients of large penetrants at high temperatures. In almost every case irradiation

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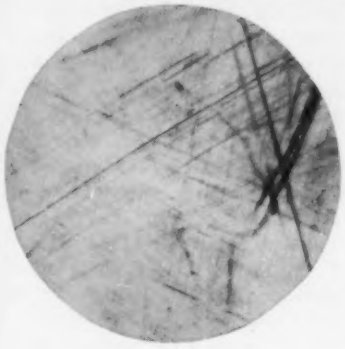

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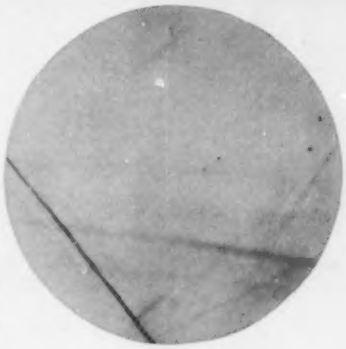

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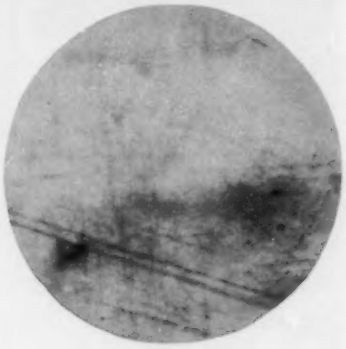

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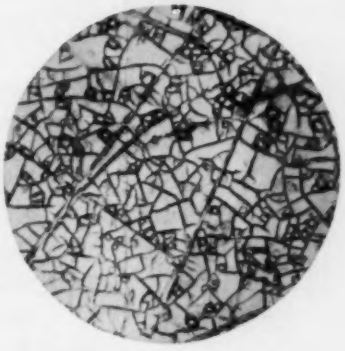

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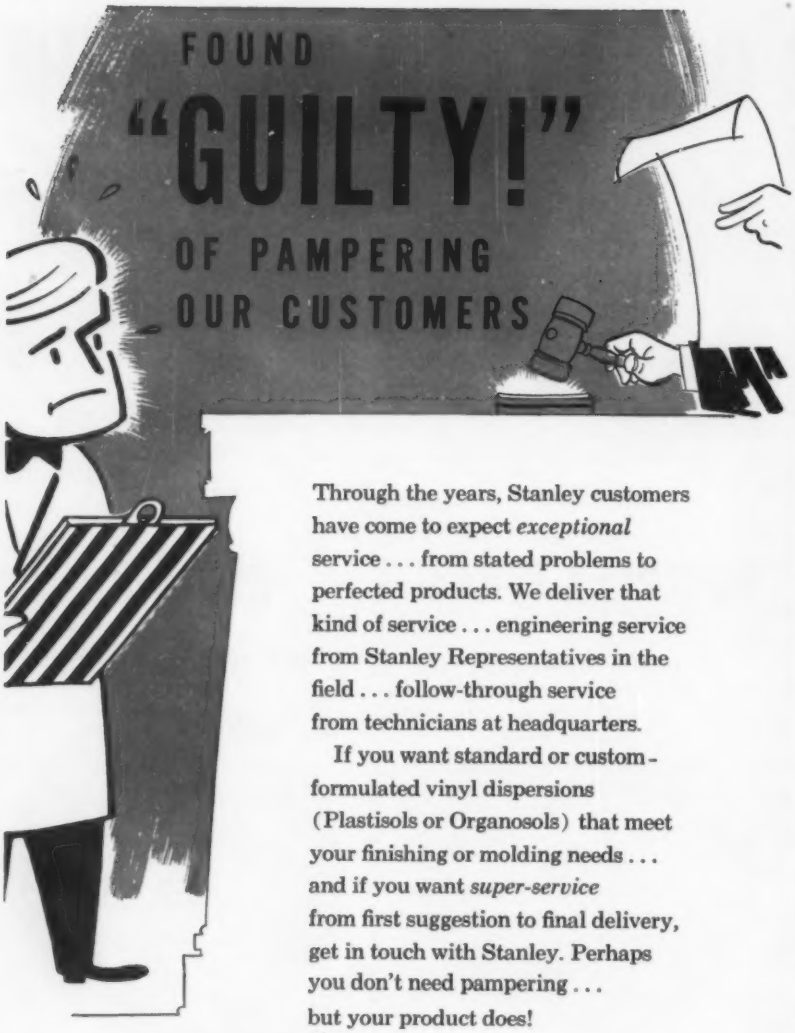

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decreased both the activation energy and the penetrant constant, and there exists a temperature at which the permeability constants of a penetrant in polyethylene and irradiated polyethylene are equal. These inversion temperatures tend to increase with increasing polarity of the penetrant. To account for these observations, it seems sufficient to assume that irradiation decreases crystallinity and increases crosslinking, that an increase in polymer crystallinity is accompanied by an increase in the quasicrystalline-like character of amorphous regions, and that small penetrants may dissolve, and diffuse, through the crystalline regions of polyethylene. It is postulated that activated diffusion in polyethylene induces structural changes in the polymer not unlike local melting. An explanation is given for the observation that flexible molecules tend to have small frequency factors compared to rigid molecules of similar activation energy. A simple, particle-in-a-box model is proposed for diffusion of small penetrants in a crosslinked polymer. This model predicts that irradiation should leave the activation energy unchanged, and should decrease the penetrant by nearly the same factor for all penetrants at all temperatures, very much as observed for nitrogen, oxygen, and carbon dioxide.

Testing

Characterization of pressure-sensitive adhesives. F. H. Wetzel. A.S.T.M. Bulletin No. 221, 64-68 (Apr. 1957). Quantitative methods for a study of factors affecting pressure-sensitive adhesion were developed. (1) Tack is determined as a surface property that defines the instantaneous adhesiveness of the tackifying resin-elastomer mass. (2) Yield stress of free films reflects the internal strength or cohesion. (3) A study of viscosity affords a scale for comparison of long-term flow. These methods have been useful in studying pressure-sensitive adhesion as a function of concentration of tackifying resin in pure rubber as well as the effects of accelerated aging. These methods

can also be utilized in studying the effects of plasticizers, fillers, and stabilizers. A study of deformation is in progress. Tack and tensile data on rosin ester-rubber systems imply a close relationship between elasticity and tack. A two-phase system involving both tackifying resin and elastomer appears to be a requisite to pressure-sensitive adhesion.

Chemistry

The irradiation of unsaturated polyester resins. A. Charlesby and V. Wycherley. Int. J. Appl. Radiation & Isotopes *2*, 26-34 (Apr. 1957). The effect of ionizing radiation on an unsaturated polyester resin is described. With sufficient radiation the liquid is converted by polymerization to a hard thermoset material without the necessity of applying external heat treatment or the prior addition of a catalyst. The changes induced in typical physical properties by progressively increasing amounts of radiation are described. It is shown that beyond a certain radiation dose no further changes occur. The properties at this point are comparable to those resulting when the resin is set by a normal catalytic technique. At lower radiation doses, some changes in properties were observed after irradiation, but they do not attain the values resulting directly from the higher doses where this aging effect is not apparent.

Publishers' addresses

A.S.T.M. Bulletin: American Society for Testing Materials, 1916 Race St., Philadelphia, Pa.
Corrosion Technology: Stratford House, 9 Eden St., London N. W. 1, England.
Electrical Manufacturing: The Gage Publishing Co., 1250 Sixth Ave., New York, N. Y.
Factory Management & Maintenance: McGraw-Hill Publishing Co., 330 W. 42nd St., New York, N. Y.
Forest Products Research Bulletin: Her Majesty's Stationery Office, London, England.
Industrial and Engineering Chemistry: American Chemical Society, 1155 Sixteenth St., N. W., Washington 6, D. C.
International Journal of Applied Radiation & Isotopes: Pergammon Press, Inc., 122 E. 55th St., New York 22, N. Y.
Journal of Polymer Science: Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y.
Journal of Prosthetic Dentistry: C. V. Mosby Co., 3207 Washington Blvd., St., Louis 3, Mo.
Plastics Technology: Bill Brothers Publishing Corp., 386 Fourth Ave., New York 16, N. Y.
Plumbing & Heating Business: 130 E. 59th St., New York 22, N. Y.
SPE Journal: Society of Plastics Engineers, Inc., 513 Security Bank Bldg., Athens, Ohio.
Transactions of the Faraday Society: Faraday Society, 6 Gray's Inn Sq., London W. C. 1, England.
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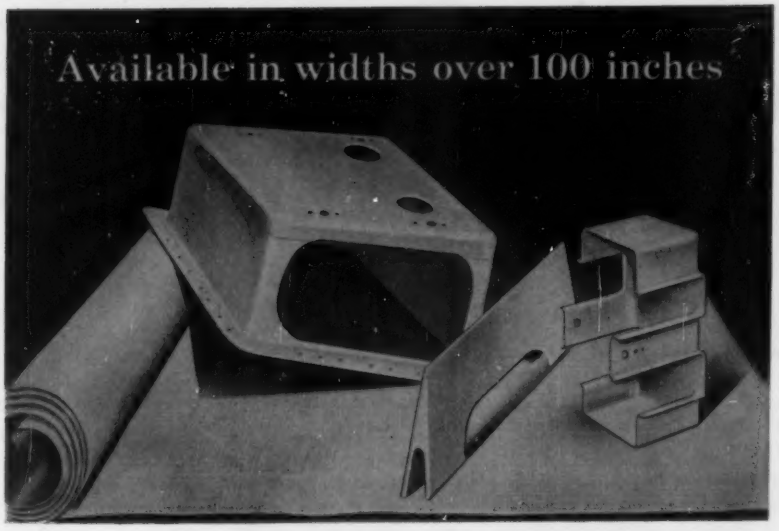

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U.S. Plastics Patents

Copies of these patents are available from the U.S. Patent Office, Washington, D.C., at 25¢ each.

Resins. M. De Groote (to Petrolite). U. S. 2,792,379, May 14. Reaction products of carboxylated phenolic resins and amine-modified phenolic resins.

Polymers. R. J. Slocombe (to Monsanto). U. S. 2,792,380, May 14. Polyacrylonitrile stabilized with fumaric acid salts.

Polymers. E. C. Shokal and H. P. Wallingford (to Shell). U. S. 2,792,381, May 14. Polymers of epoxy ethers of acetylenic alcohols.

Hollow articles. W. J. Hardgrove, Jr. U. S. 2,792,593, May 21. Molding hollow articles.

Molding. C. D. Keaton and M. F. Keaton (to Plungermatic). U. S. 2,792,594, May 21. Injection molding machine.

Net. J. W. E. Haller (to Linen Thread). U. S. 2,792,617, May 21. Thermoplastic net.

Insulator. P. Doigan (to General Electric). U. S. 2,792,871, May 21. Electrical insulating sheet of asbestos fibers and a copolymer of diallylphthalate and diethylene glycol maleate.

Breaker strip. W. J. Diamond, R. E. Wallenbrock, and E. B. Derr (to Whirlpool-Seeger). U. S. 2,792,959, May 21. Plastic breaker strip.

Desk top. C. F. Wolters (to Sperry Rand). U. S. 2,793,090, May 21. Molded plastic desk top.

Slip-resistant surface. A. A. Root (to United Shoe Machinery). U. S. 2,793,136, May 21. Slip-resistant vinyl resin surface.

Coating. N. F. Barr (to American Marietta). U. S. 2,793,141, May 21. Food container coated with vinyl copolymer-phenolic resin composition.

Plastics. V. C. Vesce (to B. F. Goodrich). U. S. 2,793,195, May 21. Preparation of pigmented plastics.

Coating. R. W. Mason (to Du Pont). U. S. 2,793,196, May 21. Organic phosphate esters as flatting agents for resin coatings.

Polymerization. K. K. Kurtz (to American Cyanamid). U. S. 2,793,199, May 21. Polymerization of acrylonitrile.

Cross-linking. F. W. West (to M. W. Kellogg). U. S. 2,793,200, May 21. Fluoro-olefin polymers cross-linked with amines.

Polymerization. C. I. Gochenour and C. F. Baranauckas (to Hooker). U. S. 2,793,201, May 21. Perhaloacrylyl peroxides in fluoro-olefin polymerization.

Polymerization. J. M. Hoyt (to M. W. Kellogg). U. S. 2,793,202, May 21. Polymerization of trifluorobromoethylene.

Polymerization. F. O. Barrett, C. G. Goebel and R. M. Peters (to Emery Industries) U. S. 2,793,220, May 21. Polymerizing unsaturated fatty acids.

Polymers. S. W. Kantor and R. C. Osthoff (to General Electric). U. S. 2,793,222, May 21. Polymers of 1,2-bis - heptamethylcyclotetrasiloxanyl ethane.

Hollow articles. W. Gallay and H. Miller (to Reliable Toy). U. S. 2,793,399, May 28. Shrinking a plasticized plastic shape by dissolving the plasticizer content.

Laminating. E. T. Armstrong. U. S. 2,793,677, May 28. Apparatus for laminating.

Bobbin. P. C. Consoletti (to Draper). U. S. 2,793,822, May 28. Molded plastic textile bobbin.

Surface treatment. E. E. Gilbert and C. B. Miller (to Allied Chemical). U. S. 2,793,964, May 28. Treating polyethylene surfaces with fluorosultanic acid to render it amber.

Reinforced plastic. J. W. Collins, D. C. Cully and W. J. Hampshire (to Goodyear Aircraft). U. S. 2,793,971, May 28. Reinforced plastic strengthened with foamed cores.

Laminates. E. O. Ganslein (to Goodyear Aircraft). U. S. 2,793,972, May 28. Metal-faced laminates.

Resins. R. S. Taylor (to Sherwin-Williams). U. S. 2,794,007, May 28. Polyepoxy resin.

Resin. V. W. Ginsler (to Allied Chemical). U. S. 2,794,008, May 28. Plasticized alkoxy-substituted formaldehyde reaction products.

Polymer blends. H. L. Jackson (to Du Pont). U. S. 2,794,010, May 28. Blends of non-electrolyte and anionic polymers.

Heteropolymers. R. R. Dreisbach and J. F. Mulloy (to Dow). U. S. 2,794,014, May 28. Copolymers of acrylic acid, allyl alcohol, and sulfur trioxide.

Polymers. H. L. Jackson and W. F. Wilkinson (to Du Pont). U. S. 2,794,015, May 28. Acrylonitrile copolymers.

Fuses. P. C. Jacobs, Jr. (to Chase-Shawmut). U. S. 2,794,098, May 28. Fuses with casings of resin-glass cloth laminates.

Shell molds. G. L. Bachner (to Bachner Valyi Development). U. S. 2,794,223, June 4. Method of making shell molds.

Molding. A. D. Morton and P. H. Vecchiolla. U. S. 2,794,233, June 4. Molding cavities in thermosetting material.

Marker. H. W. Dryden. U. S. 2,794,277, June 4. Plastic animal marker.

Tubing. A. C. Anderson (to A. O. Smith). U. S. 2,794,481, June 4. Fibrous reinforced tubular articles.

Sealing. D. R. Williams. U. S. 2,794,484, June 4. Apparatus for sealing plastic joints.

Container. A. L. Colarusso (to Van Brode Milling). U. S. 2,794,553, June 4. Plastic containers for processing sea water.

Splice. R. G. Riedesel and R. S. Frigstad (to Minnesota Mining). U. S. 2,794,726, June 4. Splicing abrasive belts with a film adhesive.

Concrete impregnation. B. J. M. Schmidt (to Internationella Siporex). U. S. 2,794,752, June 4. Impregnation of light-weight concrete with silicate and thermoplastic resins.

Reinforced plastic. R. F. Leverenz. U. S. 2,794,756, June 4. Reinforced plastics.

Mat. A. T. Dildilian (to Fiber Glass Industries). U. S. 2,794,759, June 4. Resin-impregnated fibrous glass mat.

Reinforced parts. J. H. Wilson (to Sturgis Posture Chair). U. S. 2,794,760, June 4. Fiber-reinforced plastic parts.

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dispersion
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is

CRITICAL

you need adp *concentrates*

ADP blacks are free of agglomerates. They cut compounding time; save your equipment; save you hours of clean-up time; eliminate contamination. Dispersion is a highly technical science, requiring specialized research and production techniques. ADP is unique in this respect because of its background of close to a half-century of experience.

ADP specialists, technically trained in the manufacture and use of dispersions in the plastics industry, are available for consultation without obligation. They will tell you how and why ADP dispersed blacks make better compounds at lower manufacturing cost.

ACHESON DISPERSED PIGMENTS CO.

MORRIS BUILDING, PHILADELPHIA 2, PA. A UNIT OF ACHESON INDUSTRIES, INC.

West Coast Distributor: B. E. DOUGHERTY CO., LOS ANGELES 21, CALIFORNIA
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New Machinery and Equipment*

Printing machine

A versatile printing machine uses either offset or letterpress system to print on flat and non-flat objects. It can print on three different levels simultaneously in one, two, or three colors. Objects to be printed may be up to 5 in. thick, 12 in. wide, and 18 in. long. Some pieces have been printed at rates up to 8000 per hour. A rotary indexing attachment permits printing on cylindrical and conical objects. The printer, called Cosomatic, is built by *Cosom Engineering Corp., 6012 Wayzata Blvd., Minneapolis 16, Minn.*

Injection molding machine

The No. 12-350 injection machine delivers 12 oz. with straight shooting, almost twice that amount with prepacking. Dry-cycling in 8.5 sec.: it can plasticate up to 150 lb./hr. of polystyrene at 420° F. The cylinder is fitted with a ball-joint nozzle adapter that makes it easy to align sprue bushing and heating cylinder. The injection plunger is water cooled, has fast advance and retract feature that allows it to be moved in or out in about a second. Clamping mechanism is the hydraulic-toggle type, develops up to 350 tons. Mold bases can be handled up to 20 by 31.5 in. with a 14-in. draw. Three Amplitrols regulate heating cylinder temperatures, with an optional fourth for the nozzle. The prepacking device and plunger prepositioning features are optional extras, as is a kit that converts the machine to fully automatic operation. Feed system is designed to facilitate fast changes of material. *Fellows Gear Shaper Co., Springfield, Vt.*

Mold bases

The DME 9-in.-wide series of mold bases has been replaced by a 9⅞-in.-wide series. The new bases offer 9.7% more cavity area, 14.5% more ejection area, and take up 6% less platen space than their predecessors. Dowels are tubular and stop pins are welded. The ejector housing is made in one piece. The saving in platen space was accomplished by replacing the clamping ledges with clamping slots. The lengths of the four new bases are 8, 11.9, 16, and 20 inches. *Detroit Mold Engineering Co., 6686 E. McNichols Rd., Detroit 12, Mich.*

Small injection machine

The Series II machine is fully automatic, shoots up to 1 oz. of polystyrene. Toggle - hydraulic clamp and the injection ram are driven by a 7-hp. pump, the clamp developing about 70 tons and the maximum injection pressure being 9100 p.s.i. This little machine is probably the smallest available with a preplasticating chamber; in this case it is concentric with the injection cylinder. The injection ram, therefore, acts directly on softened material, being forced backward during the stroke of an annular feed ram. Plasticating capacity is about 20 lb./hr. of cellulose acetate. Minimum dry-cycle time is 3 sec., achieved by very fast clamp action and short injection stroke. Platens are 10 by 16 in. and accept molds from 3.1 to 6.5 in. thick. For molding nylon, some modifications in cycle-timer action are made, and the performance ratings are somewhat lower. *Dowding & Doll Ltd., 346 Kensington High St., London W.14, England.*

Heat sealer

Said to be radiation-free, the Model 72-SP electronic heat sealer has a box-type construction that shields the die top, bottom, sides, and ends. Sealing operations may be carried on in unshielded rooms. The press also features easy interchangeability of sealing dies. The sealing compartment may be designed to handle many shapes of dies, can be used with generators of different output ratings. The 72-SP has a sealing compartment 6 by 12 in. in size. Press is air-operated by foot pedal, with either automatic or manual sealing cycle. Timer is built into generator, overtravel mechanism prevents start of sealing until keeper plate is fully seated. *Electronic Processes Corp. of California, 2190 Folsom St., San Francisco 10, Calif.*

Large automatic transfer molding machine

The Model HP-2½/2X-T is a 400-ton automatic transfer molding machine capable of shooting from 8 to 16 oz. of 2-stage, general-purpose phenolic resin. Transfer pressures of 8 to 9 t.s.i. can be developed on projected areas up to 45 sq. in. Cycle time is said to be half that of conventional transfer presses because the new model handles preforms so rapidly that higher-than-normal preheating temperatures

Fellows Gear Shaper injection machine Model 12-350 dry-cycles at 8.5 sec., plasticates up to 150 lb./hr. (polystyrene)

*Specifications and claims made and appearing in these pages are those of the manufacturers of the machinery and equipment described and are not guaranteed by MODERN PLASTICS.

Van Dorn

MODEL H-250 PRESS 2½ OZ.

is FAST!

Up to 1200 cycles per hour (dry run)

AUTOMATIC!

One operator can run 3 or more presses, for greater flexibility, and lower labor costs. Selective control permits semi-automatic operation.

EASILY OPERATED!

by semi-skilled help. With simple, handy controls, job can be set up in 20 minutes.

VERSATILE!

The sketches list only a few of the many thermoplastics molded on Van Dorns.

Made at Low Cost on VAN DORNS

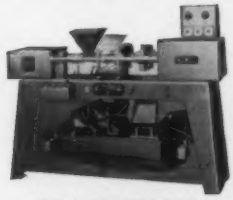
Polystyrene Containers — over 720 per hour

Vinyl Cord Sets — over 2000 per hour

Nylon Coil Forms — over 2000 per hour

Polyethylene Closures — over 9000 per hour

Remember, For the Price of One Large Press, You Can Own a BATTERY of VAN DORNS!



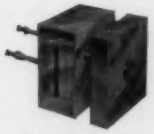
SEMI-AUTOMATIC PRESS 2-oz. capacity.

POWER OPERATED, LEVER CONTROLLED PRESSES 2-oz. and 1-oz. models.

WRITE FOR complete data on model H-250 and other equipment shown.

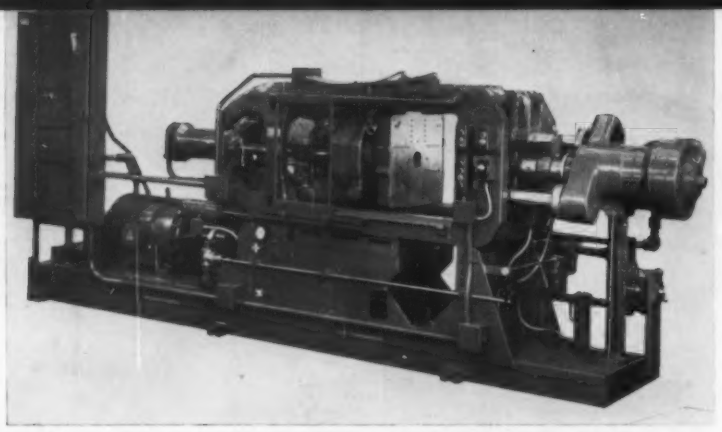
FINANCING AVAILABLE

PLASTIC GRINDER Grinds up rejects, waste, etc., for re-use.



MOLD BASES Available from stock.

THE VAN DORN IRON WORKS CO., 2685 EAST 79th. ST. • CLEVELAND 4, OHIO



Lester-Phoenix Model HP-2½X-T is an automatic transfer molding machine developing transfer pressures of 8 to 9 tons/sq. in.

(300 to 325° F.) can be used without danger of precuring. Mold temperatures also are higher, running between 365 and 410° F. One man can handle two, perhaps four machines. Molding-in of inserts presents a special problem, but can probably be worked out with semi-automatic cycling. Recommended auxiliary equipment (at extra cost) is LaRose electronic preheater and a Syntron vibrator bowl feeder. *Lester-Phoenix, Inc., 2711 Church Ave., Cleveland 13, Ohio.*

Regrinder-blender-loader

The Foremost models 2A-3 and 3C-2 scrap regrinders combine blending and loading functions with grinding to accomplish five tasks: 1) unloads virgin material from drum, 2) grinds scrap fed to it, 3) proportions and mixes reground with virgin material, 4) loads blend into feed hopper, and 5) keeps hopper level constant. The unit supplies its own air. Power ratings on the two models are 1.5 hp. and 3 hp. respectively, while the throat openings are 7.5 by 8 in. and 10 by 12 inches. *The Rainville Co., Inc., 224 Seventh St., Garden City, N. Y.*

Pulsation absorber

Hydraulic shock due to rapid changes of fluid momentum accompanying opening and closing of solenoid valves and the operation of certain pumps (duplex, triplex types) frequently results in damage to line joints and valve packings. Much of this damage can be eliminated by installing accumulators at strategic points in the hydraulic system. The Greer hydro-pneumatic accumulator is available in a wide range of sizes for pressures up to 3000 p.s.i. Because the energy-absorbing air cushion is contained in a butyl rubber envelope, these accumulators don't suffer from loss of air and can be operated in non-vertical positions. *Greer Hydraulics, Inc., New York International Airport, Jamaica 30, N. Y.*

High-pressure pump

A pump intended for hydraulic power applications develops 5700 p.s.i. The delivery of any one size pump can be adjusted to any desired value within its range or can be set to vary automatically and inversely with pressure changes. This inverse variation is a money saver in press operation, where limited delivery holds the press while it is closed. Sizes from 1.5 to 30 hp. are available either as bare pumps or as packaged power units. *Vibro Mfg. Co., Woodside, N. Y.*

Ultrasonic thickness gage

The Vidigage uses an ultrasonic transducer to gage (from one side) the thickness of a wide range of materials—plastics, metals, etc.—in thicknesses from 5 mils to 2.5 inches. Accuracy depends on range of thicknesses to be gaged, but may be as high as 0.05%. Instrument picks up internal flaws—bubbles, delamination—as well as changes in external thickness. It has no moving parts, may be obtained in frequencies from 0.7 to 25 mc., depending on application. Indicatin scale is 17 in. long, and a re corder of equal accuracy can b attached. The gage is easily adapted to control work. *Branson Instruments, Inc., 37 Brown House Rd., Stamford, Conn.*

Hydraulic presses

A new line of hydraulic presses includes models rated for 65, 125, 170, and 300 tons. It is also possible, with easily installed kits, to later convert the 65-ton press to any of the higher tonnages. The entire hydraulic unit is mounted in a tray on top of the press. Platen dimensions of all four models are 26.8 by 32 in., with a daylight opening of 25 in. The press may be opened at either of two speeds, 2.7 in./sec. or 130 in./sec., and may be closed at either 1.55 or 93 in./sec. The stroke is 12 inches. Platens may be heated electrically, with steam, or with oil, or not heated at all. Multiple platens can be supplied. *A. Dale Herman, Inc., 17071 Ventura Blvd., Encino, Calif.*

Multi-wash paint spray booths

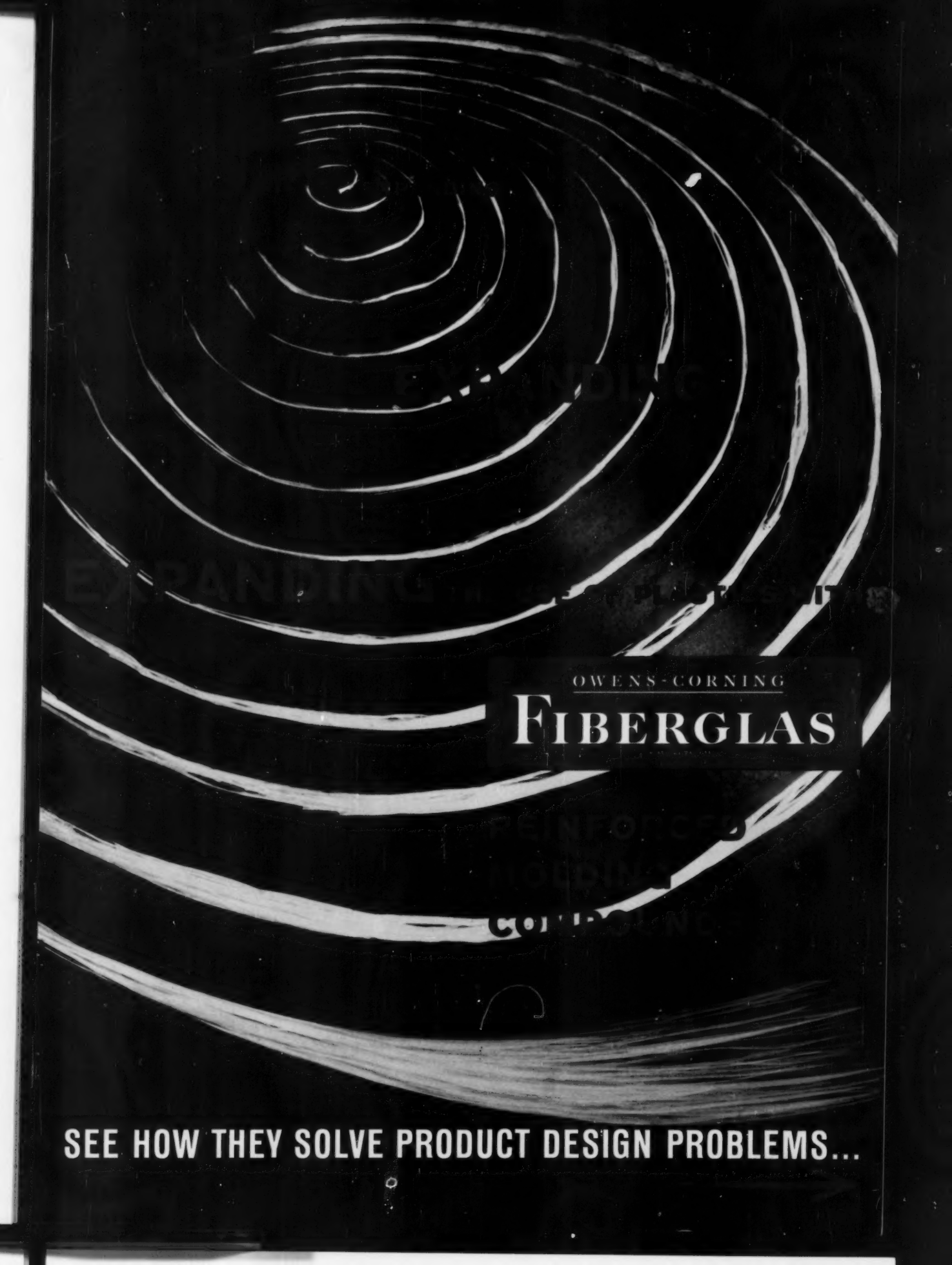
Maintenance costs and fire hazards are reduced by a paint spray booth which incorporates four separate stages of washing for the exit air. Tests show less than 0.5 grain of paint solids per 1000 cu. ft. of washed exhaust air, and these particles are so fine they no longer have adhesive properties. Booth sizes range from 4 to 10 ft. wide, with corresponding exhaust fan ratings ranging from 2 h.p. and 3000 c.f.m. to 5 h.p. and 7500 c.f.m. Water requirements range from 120 to 300 g.p.m. *Ramco Equipment Corp., 1373 Lafayette Ave., New York 59, N.Y.*

Impact testers

The TMI impact tester makes both Izod and Charpy impact tests in three capacity ranges (6 hammers are furnished). Each hammer is a welded, one-piece unit, eliminating errors associated with detachable weights. Maximum energy absorption is 30 foot-pounds. *Testing Machines, Inc., 123 W. 64th St., New York 23, N.Y.*

The UST impact tester, also of the pendulum type, measures the energy remaining in the pendulum after the sample has been broken by measuring the *time* of

(*To page 207*)


OWENS-CORNING
FIBERGLAS
SEE HOW THEY SOLVE PRODUCT DESIGN PROBLEMS...

ALL THE PROPERTIES OF PLASTICS...PLUS

✚ Heat Resistance
✚ Strength
✚ Dimensional Stability

Faces the elements on the open road

This cover fits snugly over a heavy truck transmission housing. It protects internal working parts from water, sand, salt, ice-melting chemicals and other road hazards.

Obviously, here's a job that calls for strength and corrosion resistance. Designers obtained these properties by molding both cover sections of Fiberglas*-reinforced polyester molding compound. Two years of rugged tests under varying road conditions *prove* that these molded parts can withstand the wear and tear of the highways.

In this application, a Fiberglas-reinforced molding compound offered these important advantages over metal: lower tooling and assembly costs, lighter weight and permanent corrosion resistance with no painting required.

END USER: *International Harvester Company, Chicago, Ill.*

MOLDER: *Advance Products Company, Toledo, Ohio*

MOLDING COMPOUND: *Fiberglas-reinforced polyester*

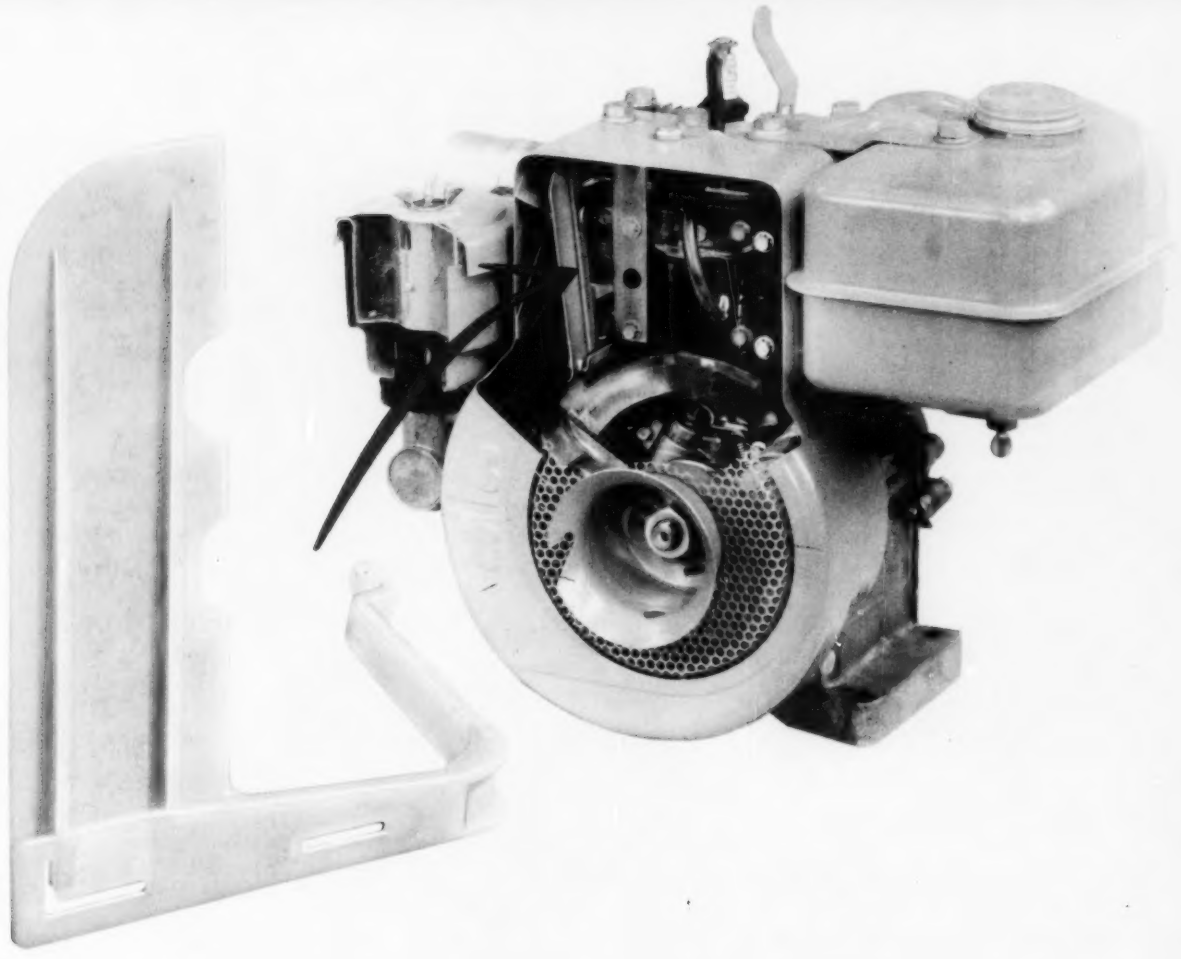
OWENS-CORNING
FIBERGLAS

REINFORCED

*T.M. (Reg. U. S. Pat. Off.) O-C. F. Corp.

PLASTIC MOLDING COMPOUNDS with Fiberglas reinforcement have surmounted many of the limitations which molded plastics impose on the designer. For Fiberglas-reinforced molding compounds make products that are far stronger . . . more resistant to temperature extremes . . . with better dimensional tolerances and stability than have ever before been possible. In effect, they are opening up a whole new world of design opportunities.

Yet Fiberglas-reinforced molding compounds have all the good properties, processing advantages and economies you associate with molded plastics. They're formed in standard transfer, injection or compression molding equipment and introduce no new problems in handling or processing. On these pages, you see a few of the many new products designed with Fiberglas-reinforced molding compounds to attain all the properties of plastics . . . plus!



Replaces metal in engine "hot spot"

A key working part on the Briggs and Stratton engine shown here is the "blade governor", above, left. Spring-loaded in the air-intake chamber, it automatically regulates the air flow into the carburetor according to the load on the motor. Its close proximity to the engine block means that the part must withstand temperatures exceeding 250° F.

This blade governor was formerly made of metal, but is now molded of Fiberglas-reinforced nylon. After exploring various plastics, designers found that only *Fiberglas-reinforced* nylon could provide the strength and rigidity in thin sections—along with excellent heat resistance—required here.

Because of the molding compound's lighter weight, the governor assembly now exhibits more sensitive action . . . responds more quickly to changes in motor load. Once again a Fiberglas-reinforced molding compound shows it can do the job of a metal in a functional part . . . and do it better.

END USER: *Briggs and Stratton Co., Milwaukee, Wisconsin*

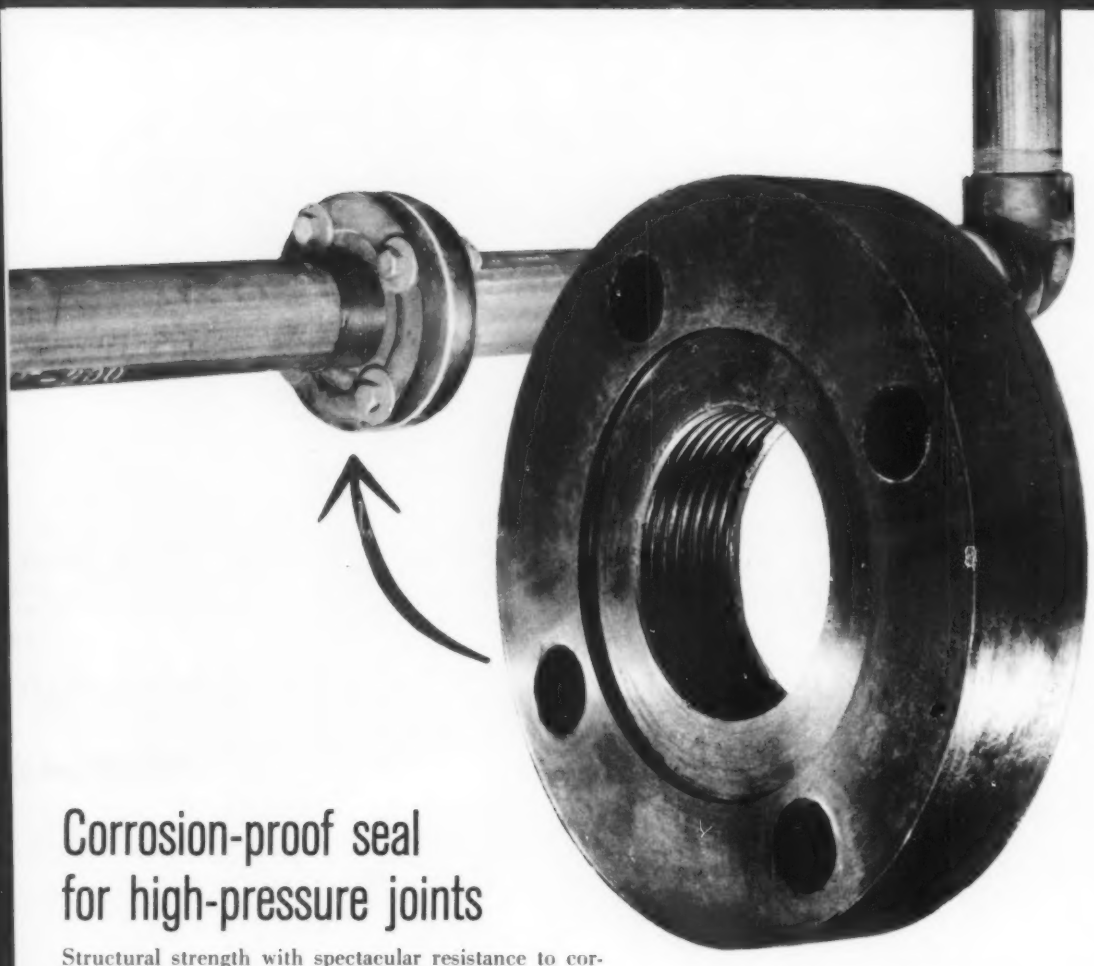
MOLDER: *Federal Tool Corporation, Lincolnwood, Illinois*

MOLDING COMPOUND: *Fiberglas-reinforced nylon by Fiberfil, Inc., Warsaw, Indiana*

MOLDING COMPOUNDS→

ALL THE PROPERTIES OF PLASTICS...PLUS

✚ Heat Resistance
✚ Strength
✚ Dimensional Stability



Corrosion-proof seal for high-pressure joints

Structural strength with spectacular resistance to corrosion are the stringent requirements for this flange. It connects Fiberglas-reinforced plastic pipe sections in a system designed to carry *highly corrosive* liquids under pressure.

To meet these severe operating conditions, the flange is molded from Fiberglas-reinforced polyester molding compounds, chosen for superior strength and ability to resist strong corrosive agents. In addition, excellent dimensional stability guarantees that all joints will stay tightly sealed.

This is another example of the ways in which the special properties of Fiberglas-reinforced molding compounds are solving design problems for industry.

END USER: *Fibercast Division, Youngstown Sheet and Tube Co., Tulsa, Oklahoma*

MOLDER: *Fibercast Division*

MOLDING COMPOUND: *Fiberglas-reinforced polyester by Thermaflow Products Chemical Division, Atlas Powder Co., Wilmington, Delaware*

THE CASE HISTORIES on these pages illustrate just a few of the thousands of products which have been profitably fabricated with Fiberglas-reinforced molding compounds. **Write now for our complete file of case histories and a list of suppliers of Fiberglas-reinforced molding compounds.**

OWENS-CORNING
FIBERGLAS

TEXTILE PRODUCTS DIVISION
Dept. 125-I, 598 Madison Ave., N.Y. 20, N.Y.

Owens-Corning Fiberglas Corporation produces only the reinforcement for the manufacturers of reinforced molding compounds.

the after-swing to the nearest milli-second, instead of measuring the distance, as usual. This method gives greater accuracy. Because particular attention has been paid to eliminating the possibility of operational variability, the values of impact strength obtained are said to be highly reproducible, even among different operators. Several striking heads are available. Suitable for any materials from thin films to heavy boxboard. *United States Testing Co., 1415 Park Ave., Hoboken, N.J.*

Specifications of IMS mold chillers

Injection machine		Circulating pump	Pump characteristics				
			Vol.	Head	Vol.	Head	B.t.u./hr.
oz.	hp.	hp.	gal./min.	ft.	gal./min.	ft.	
2 to 3	1.5	0.5	10	60	40	20	21,500
6 to 8	3	1	15	70	60	45	46,480
12 to 16	5	1.5	15	110	70	50	68,000

Arc resistance tester

Arc resistance has been difficult to define and to measure reliably. This instrument has several features designed to improve test reproducibility: a built-in timer, a specimen holder that automatically levels and sets the correct electrode pressure, a transparent electrode enclosure that permits excellent visibility during test (a necessity) and yet protects the arc from drafts, and an easily cleaned electrode assembly. An interlocked high-voltage electrode protects the operator. The Model 126 tester meets the requirements of ASTM Spec. D495-56T and Federal Spec. L-P-406b, Method 4011.2. *Delsen Corp., 719 W. Broadway, Glendale 4, Calif.*

Adhesive tester

The Bashore T-A-C tester can measure cohesive force, time, and distance in shear and peel on 3-in.-diameter cylinders or flat surfaces. Under similar conditions, the instrument can also measure grab or set force, time, and distance; and adhesive force, time, and distance. As a process monitor, it is capable of measuring tack time, viscosity level, solids level, and similar factors on which adhesive performance depends. *Durolastic Co., Broadway, N.J.*

Mold chillers

Expressly designed for handling the large volumes of water needed to effectively chill injection molds, a new line of mold chillers can extract from 20,000 to 68,000 B.t.u./hr. from molds at temperatures ranging from 20 to 90° F. (circulating liquid is Prestone solution). Maker's aim is "to offer a chiller that can be economically operated and maintained by the average injection shop without undue expense." All three models come complete with casters, magnetic starters, and everything needed for immediate operation. Specifications are listed in the table. *Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio.*

Polyethylene laminator

A new extrusion laminator for polyethylene is designed to fill the need for a high-speed pilot-plant and commercial unit in the web-width range from 24 to 48 inches. The machine is a combination of a Model UAL unwind stand with a Model PL-450 laminator, both being mounted on a single base. Jacks on the base permit precise adjustment of air gap, etc. The steel chill roll is of spiral-fluted, rubber-ribbed construction designed to give large heat-transfer coefficients. The rubber-covered pinch roll retracts rapidly to a distance of 6 in. from the chill roll. *Dilts Div., The Black-Clawson Co., Fulton, N. Y.*

Automatic insert loader

The Freeloader automatically aligns and loads inserts into a preloading board, properly oriented for placement into the waiting mold. Using the "blow-loading" principle, it can handle screw-machine parts, stamped parts, and a variety of others. It handles almost any number of parts with equal efficiency, thus reducing tremendously the insert-loading time in jobs involving many inserts. A 1-in. No. 10 screw loads as easily as a subminiature electronic terminal, loading generally being accomplished in from 0.5 to 3 minutes. Three models are available: A-3 with double drums having individual drives; A-2, double drums with a single drive; and A-1, single drum. *Whitso, Inc., 9330 Byron St., Schiller Park, Ill.*

Vacuum press unloader

The Vac-Hand is a suction cup connected to a vacuum line. As part of the PAS line of press unloaders, it reaches into a just-opened press and grips the finished piece. The adjustable arm is pivot-mounted and is operated by a 45-p.s.i. air cylinder. The flexible rubber cup is soft enough to conform to either flat or curved surfaces, and leaves no marks. It can handle a wide variety of part shapes and sizes, replacing an assortment of jaw-type fixtures. The Vac-Hand can be mounted on standard PAS straight-line, air-powered unloaders without alteration. *Press Automation Systems, Inc., 25418 Ryan Rd., Centerline, Mich.*

Jointing panel saw

The Model ML R-P saw is designed for fabricators of plastics and laminates who require perfectly jointed cuts in flat stock. Mounted on solid 2-in.-diameter rails of steel shafting, it can produce cuts within a tolerance of 8 mils in a 4.5-ft. pass. The carriage is drawn from its center by a chain-and-sprocket mechanism. It is available in capacities from 4.5 to 12.5 ft., with motors from 1 to 3 horsepower. The 14-in. blade cuts to depths up to 5.9 inches. *Hendrick Mfg. Corp., Marblehead, Mass.*

20/28-oz. injection machine

The Model 450-HV-20/28 is built for fast, continuous production with close control of quality. Special features include: 1) grouped controls, 2) weigh feeder as

NOW... EMERY 3049-S

a new high mol.-wt. Polymeric Plasticizer that PROCESSES EASILY!

Emery 3049-S*, a new polymeric plasticizer, imparts all the extreme permanance properties to vinyl materials, yet processes easily on conventional equipment. In fact, 3049-S can be used as the sole plasticizer without incurring processing or compatibility difficulties.

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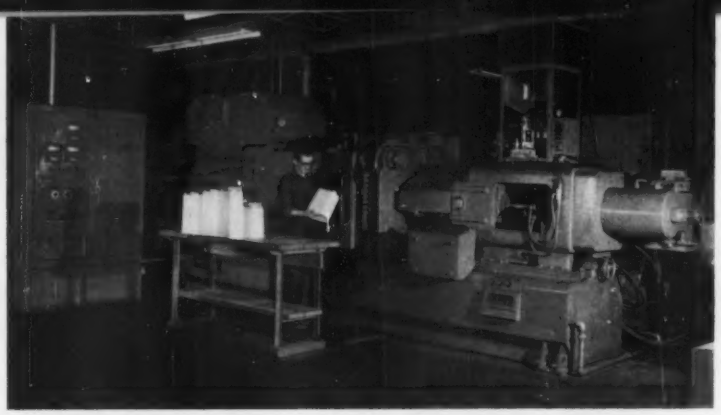

H-P-M Model 450-HV-20/28 has plasticating capacity of 200 lb./hr., overhead oil tank, and independent injection and clamping circuits

tan'a d equ p ent 3) overhead oi tank, resulting in positive gravity prefill and less risk of contamination, 4) independent injection and clamping circuits, 5) separate pilot pump for operating valves and a hydraulic device that eliminates hydraulic shock, 6) plug-in timers. General specifications are listed in the accompanying table. *The Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.*

Specifications of H-P-M Model 450-HV-20/28

Shot capacity, oz.	20
with prepacking, oz.	28
Plasticating capacity, lb./hr.	200
Top injection pressure, p.s.i.	20,000
Injection stroke, in.	12
Max. rate of injection, cu.in./sec.	1530
Mold clamping force, tons	450
Max. ejection stroke, in.	4
Fast closing speed of clamp, in./sec.	11.8
Slow closing speed, in./sec.	0.88
Slow opening speed, in./sec.	1.62
Fast opening speed, in./sec.	10.2
Ejector speed, in./sec.	1.62
Dry-cycle time, sec.	9
Max. mold size, height x width, in.	26.5 × 36 or 20.5 × 42
Max. daylight opening, in.	40
Min. mold thickness (with spacer), in.	9
Pump motors (2), hp.	50 and 25

Portable ribbon blenders

A new line of portable ribbon blenders is available in working capacities ranging from 0.34 to 20 cu. ft. A choice of materials can be had: carbon steel, stainless, or Monel, with or without cooling jackets. All are mounted on carters. Agitation is accomplished by single or double ribbons or by paddles. Quick-opening clamps hold down the dust-tight, hinged covers. Discharge can be made either from the center or one end. Furnished with motors and drives. *The Young Machinery Co., Muncy, Pa.*

Double-action drum mixer

The Lisco drum mixer is said to be the only one that combines a tumbling action with rotation of the drum. The drum is longitudinally oscillated 56 times per min., rotated 28 r.p.m. The mixer will handle drums of almost any size and shape. It is driven by a 1-hp. motor. A junior model, designed to handle 5-gal. cans (or two 1-gal. cans end to end) has the same action, is powered by a ⅓-hp. motor. *Lansing Industrial Sales Co., 2301 W. Main St., Lansing 17, Mich.*

Impact tester

A combination Izod and Charpy impact tester can make these tests in either of three energy ranges. There is a separate hammer for each range, making six in all. Each is a one-piece welded unit, eliminating errors connected with screwed-on weights and detachable bits. Meets ASTM test requirements. Energies up to 30 ft.-lb. are available. *Testing Machines Inc., 123 W. 64th St., New York 23, N. Y.*

High-pressure valves

Diaphragm-operated high-pressure control valves, now available in a complete line, are useful in systems carrying oil, air, steam,

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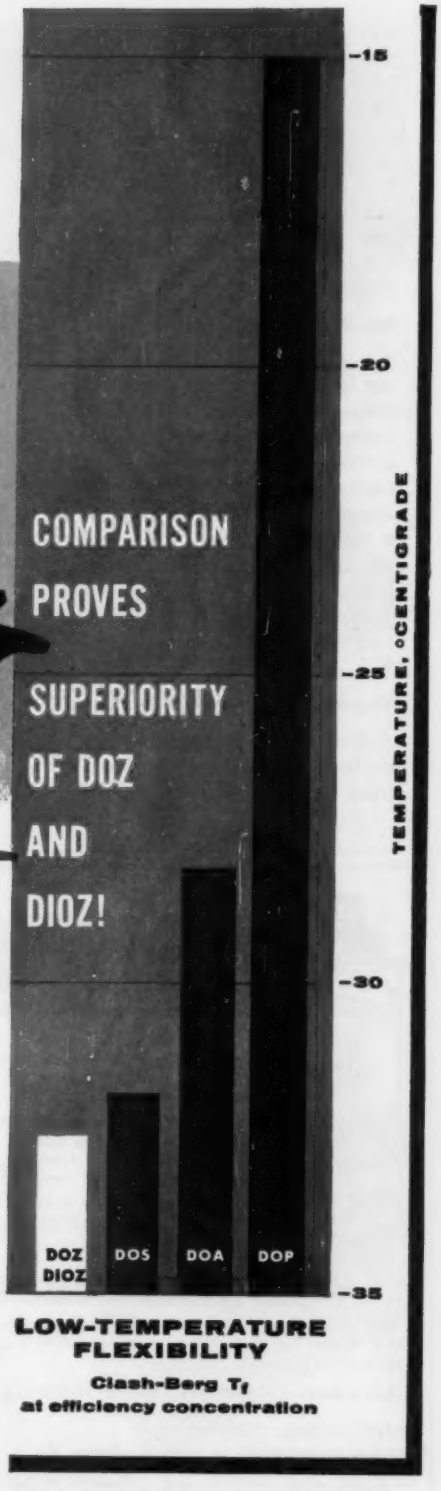

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and hot or cold water at pressures up to 6000 p.s.i. Corrosion resistance is assured by the Monel valve stem, hardened stainless steel seat sleeves, and high-tensile Navy M bronze bodies. Stellite seats are electro-bonded to the Monel stem, and stainless seat sleeves are easily replaced. *Sinclair-Collins Valve Co., 454 Morgan Ave., Akron 11, Ohio.*

Small sheet laminator

A convenient table-top machine for laminating acetate and other films to book covers, charts, etc., operates without use of heat or solvents. It can handle sheets or continuous webs in widths up to about 18 inches. Suggested also as a laboratory tool for paper converters and others who wish to make samples of proposed production laminations. *Rotobond Co., P.O. Box 69, Bound Brook, N.J.*

Experimental liquid mixer

A small mixer intended as a laboratory test instrument to gather data for large-scale mixing of a particular liquid system is operated by a ¼-hp. motor that can be varied in speed from 0 to 1100 r.p.m. A variety of propellers, turbines, and paddles are furnished with it, along with shafts of several lengths. The makers have assembled the most useful of the available information on agitator scale-up into a 46-page booklet that is part of the kit. An accessory is a test stand and ball-bearing motor mount that makes it possible to determine torque (ergo, power) required in mixing (see cut). The test stand is large enough to accommodate a 16-gal. vessel. Baffles, swivel mount, special blades, and explosion-proof motor are extras. *Chemineer, Inc., 1044 E. First St., Dayton 2, Ohio.*

Accessory test stand for Chemineer liquid mixer permits determination of torque required in mixing

Release for porous casting molds

Sonite Seal-Release was developed for separating epoxy or other resin castings from plaster, gypsum cements, wood, metal, and plastics. A soft jelly, it may be applied by rubbing, brushing, or spraying. It can be sprayed if thinned with naphtha or gasoline. It is recommended for epoxy forming molds from sheets formed in them, or from the plaster master used in casting the mold itself. *Smooth-On Mfg. Co., 572 Communipaw Ave., Jersey City 4, N.J.*

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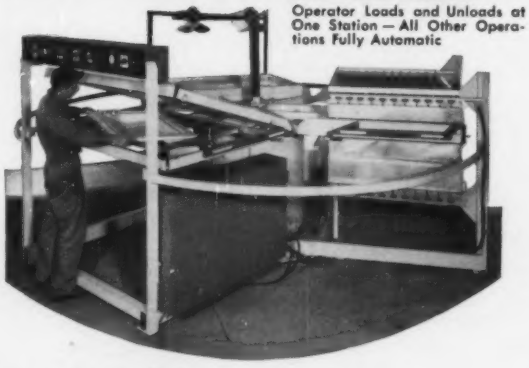

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Books & Booklets

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"ASTM Standards on Plastics"

Published in 1957 by the American Society for Testing Materials 1916 Race St., Philadelphia 3, Pa., under the direction of Committee D-20. 856 pages. Price: $6.00 ($4.50 to members).

The latest version of this valuable book of specifications, test methods, and nomenclature on plastics contains 34 new or revised items. Mechanical, thermal, optical, and performance properties of plastics are covered, as well as materials standards, recommended practices for molding, test specimens, etc., and analytical methods.

"Resins-Rubbers-Plastics Yearbook 1956"

Edited by H. Mark, E. S. Proskauer, V. J. Frilette

Published in 1957 by Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. 1144 pages. Price: $35.00.

Although representing a collection of abstracts of papers dealing with the properties and behavior of resins, rubbers, and plastics—material originally published in 1956 in the outstanding domestic and foreign journals—these abstracts are far more complete than those conventionally used, in many cases containing original data, graphs, charts, photographs, etc., so that readers will not always find it necessary to go to the original work.

"A Guide to the Literature of Chemistry, 2d Ed."

By E. J. Crane, A. M. Patterson, and E. B. Marr

Published in 1957 by John Wiley & Sons, New York, N. Y. 397 pages. Price: $9.50.

The literature of chemistry has immensified since the first edition of this book came out in 1927. Since then the first edition has been of tremendous help to searchers of the chemical literature, and the new edition will be welcomed for its more complete coverage of the burgeoning periodical literature. Two new chapters have been added on trade literature and government publications. "Particular attention was given to listing collective indexes and to giving the changes that have occurred in the names of important journals throughout most of their existence." The chapter on Procedure in literature searches differs greatly from the one in the first edition, and "should be much more useful for initiating chemists in the art of literature searching."

"Polythene"

Edited by A. Renfrew and P. Morgan

Published in 1957 by Iliffe & Sons Ltd., Dorset House, Stamford St., London, England. 567 pages. Price: 127s. 9d., postpaid; published in U. S. by Interscience Publishers, Inc., 200 Fifth Ave., New York 1, N. Y. Price: $18.50.

The subtitle of this book, "The technology and uses of ethylene polymers," is a good description of its contents. While there is some duplication of material between this volume and "Polyethylene," by Raff and Allison (1956), the point of view is that of the technologist rather than the scientist, resulting in a large variance of emphasis. The work (by 37 contributors) is divided into three main parts: manufacture and properties, processing techniques, and applications and prospects. Section II includes four chapters on extrusion, one on injection molding, one on centrifugal casting of large pipe, a chapter on paper coating, one on bottle making, one on sprayed coatings, and one on dip coating. A broader scope might have been achieved if the extrusion group had been lightened to make room for chapters on heat sealing of film, on hot-gas welding, on sheet thermoforming, on printing and metallizing, and on adhesive bonding. Some of these topics get cursory treatment in Part III. One wonders why the chapter on electrical properties was limited to dielectric properties—resistivity (surface and volume) and arc resistance are certainly of equal practical importance. Except for these omissions, however, the book is an up-to-date and complete survey of all aspects of the polyethylene field.—*J.F.C.*

"Glasfaserverstaerkte Kunststoffe"

By Harro Hagen

Published in 1956 by Springer-Verlag, Reichpietschufer 20, Berlin W 35, Germany. Price: DM 48.60 (ca. $11.75).

Based on personal investigation in the United States and a thorough search of U. S. and English literature, this monograph constitutes the first German overall treatise on the subject of reinforced plastics. The author covers raw materials (resins, activators, accelerators, reinforcements, etc.), physical properties of glass reinforced plastics, processing techniques, finishing, and fabricating. Chapters on method of test, areas of application, and the patent situation are also included. Profusely illustrated with photos and diagrams. Numerous literature references. Index.

Industrial heating facts. Basic concepts of industrial heat processing and heat control, without technical language. 20 pages. *Michigan Oven Co., 415 Brainard St., Detroit 1, Mich.*

Solvents. Properties and applications of Freon fluorinated hydrocarbon solvents in industrial cleaning jobs. Technical booklet F-S 1. 16 pages. *E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del.*

"Manual of Laboratory Safety" covers accident prevention, first aid, fire prevention, and safety equipment. Included are a bibliography and a section on handling

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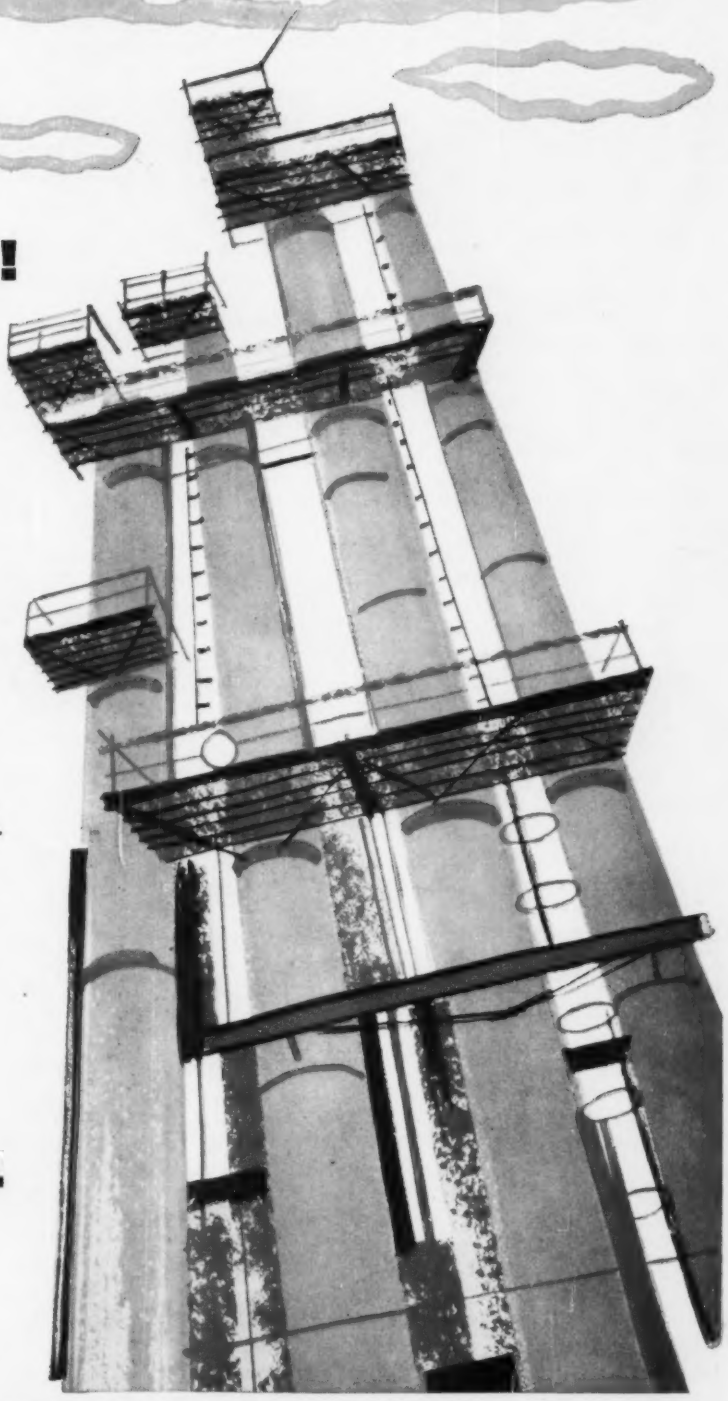

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radioactive materials and the use of isolation units for hazardous microbiological and clinical procedures. Bulletin FS 201. 56 pages. *Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.*

New lubricating system. Bulletin No. 70 describes Lubrival, a new type circulating oil system for application on presses and semi-automatic or automatic machine tools, etc., with built-in return oil arrangements. 8 pages. *The Farval Corp., 3249 E. 80 St., Cleveland 4, Ohio.*

Teflon spaghetti tubing. Dielectric, handling, and performance advantages of Polypenco Teflon spaghetti tubing, together with proved applications, electric and physical property data, and a specification table of 26 different sizes in ten different colors. Bulletin sheet BR-4A. *The Polymer Corp. of Pennsylvania, 2140 Fairmont Ave., Reading, Pa.*

"Research on Shell Molding." A number of ways to conserve costly phenolic resin used as a binder in shell molds for metal castings. Report PB 121031, Massachusetts Institute of Technology for Frankford Arsenal, U. S. Army, May 1953. Price: $1.50. 54 pages. *Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C.*

Extruded acrylic sheets. Handling, machining, forming, cementing, and annealing of Cadco extruded acrylic sheets, together with a table of properties and light transmission charts. Bulletin EX-101. 12 pages. *Cadillac Plastic & Chemical Co., 15111 Second Ave., Detroit 3, Mich.*

Epoxy hardener. Physical properties, handling, mixing, and curing of Sonite No. 41, a low-viscosity curing agent that combines readily with liquid epoxies at room temperature. Technical bulletin sheet No. 13. *Smooth-On Mfg. Co., 572 Communipaw Ave., Jersey City 4, N. J.*

"Introduction to Printed Circuits" covers the processes used for the manufacture of plastics- and ceramic-based printed circuits—etched, plated, stamped, pressed powder, embossed wiring, double foil, and die blanked—and describes the servicing techniques and problems associated with them. Price: $2.70. 112 pages, paper covers. *John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y.*

Pipe covering. Sizes, prices, and technical data for Styrofoam expanded polystyrene plastic foam for low-temperature pipe covering, and sizes and prices for domestic pipe size coverings to combat condensation problems on cold water pipes in the home. 4 pages. *Glo-Brite Products, Inc., 6415 N. California Ave., Chicago 45, Ill.*

Adhesive. Data on function, composition, properties, consistency, uses, application, and advantages of Thixon 11164 rubber-to-metal bonding adhesive. Bulletin No. 03-5-3-5-57, 3 pages. *Harwick Standard Chemical Co., 60 S. Seiberling St., Akron 5, Ohio.*

Vulcanized fibre. "CDF Materials Handling Containers" gives uses, sizes, colors, and other important information for complete line of vulcanized fibre trucks, trays, boxes, baskets, seamless roving cans, and barrels. 16 pages. *Continental-Diamond Fibre Corp., Newark, Del.*

Industrial ovens. Batch and conveyor type ovens, various air recirculating and heating systems available, and control and safety equipment for baking, drying, curing, and heat treating. Bulletin No. 157. 16 pages. *Young Brothers Co., 1831 Columbus Rd., Cleveland 13, Ohio.*

Polyethylene film. Case histories of how Bakelite polyethylene film used by brand name packers in the meat and poultry industry provides maximum protection and economy in packaging is the theme of "It Pays to Line Up with Polyethylene on Your Side." 12 pages. *Bakelite Co., Div. of Union Carbide Corp., 30 E. 42nd St., New York 17, N. Y.*

Conveyor strip. Complete specifications and a number of applications for Rapistan Flow Track, a gravity conveyor strip that can be combined with other conveyors or used in various combinations of itself. Form Sheet FT-57. *The Rapids-Standard Co., Inc., 342 Rapistan Bldg., Grand Rapids, Mich.*

"The Isotope Index," 1957 ed., covers the A.E.C. licensing procedure; available radioactive isotopes; labeled compounds; standard, radiographic, and therapeutic sources; stable isotopes; suppliers; and useful general information. Price: $3.00. 100 pages, paper covers. *Scientific Equipment Co., 23 N. Hawthorne Lane, Indianapolis 19, Ind.*

Polyethylene ware. Latest developments in polyethylene ware for laboratories and clinics, plus price schedule. Bulletin FS-268. 8 pages. *Fisher Scientific Co., 374 Fisher Bldg., Pittsburgh 19, Pa.*

Epoxy adhesives. Properties chart on Epibond adhesives and Epocast pastes for industrial uses including structural, electrical, tooling, assembly, etc. *Furane Plastics Inc., 4516 Brazil St., Los Angeles 39, Calif.*

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Cyclohexane. Properties and essential information for the safe handling and storage of cyclohexane, including engineering control of hazards, waste disposal, medical management, and employee safety. Safety Data Sheet SD-68. Price: 30¢. 16 pages. *Manufacturing Chemists' Assn., Inc., 1625 Eye St., N. W., Washington 6, D. C.*

Pipe standards. New Commercial Standards on plastic pipe, proposed by S.P.I., are available as follows: "Flexible Polyethylene Plastic Pipe (Second Ed.), Commercial Standard CS 197-57." Price: 10¢; "Dimensions and Tolerances for Solvent Welded (SWP Size) Cellulose Acetate Butyrate Pipe, Commercial Standard CS 206-57." Price: 5¢;

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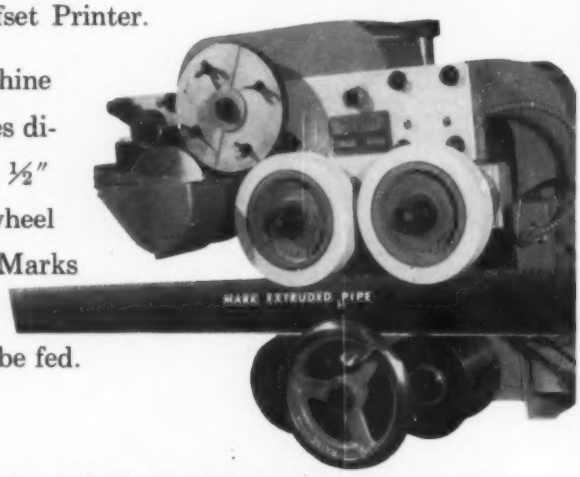

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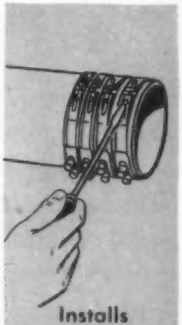

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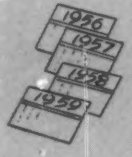

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and "Dimensions and Tolerances for Rigid Polyvinyl Chloride Pipe," Commercial Standard CS 207-57. Price: 5¢. *Superintendent of Documents, Government Printing Office, Washington 25, D. C.*

Plastics for buildings. "Plastics Products: A Research Study of Approvals by the New York City Board of Standards and Appeals from Jan. 1, 1947, to May 21 1957," points up, among others, the need for numerous building code changes before plastics pipe can be sold in New York City. 5 pages. *Joseph Platzker, Consultant, 116 John St., New York 38, N. Y.*

Plastics deflashing. "The Case for Mechanical vs. Manual Deflashing" describes how mechanical deflashing of plastics has resulted in saving of money, manhours, tooling costs, and productive space. 8 pages. *Wheelabrator Corp., 1254 S. Byrkit St., Mishawaka, Ind.*

Urethane. Technical Bulletin No. 5 on urethane gives physical properties, specifications and analysis, commercial information, chemical properties, and a bibliography. 5 pages. *Organic Chemicals Div., Food Machinery and Chemical Corp., 161 E. 42nd St., New York 17, N. Y.*

Pneumatic controllers. Basic concepts of narrow band, proportional, reset, derivative, and reset plus derivative control actions; selective, cascade, and ratio control; and descriptions of Series 500 pneumatic recording and indicating controllers. Bulletin A130. 44 pages. *The Bristol Co., Waterbury 20, Conn.*

Plastic pipe. The development, application, installation, and specifications of SP plastic pipe made from what the company says is a recently developed, superior, new-type polyethylene resin. Catalog No. 401. 9 pages. *Orangeburg Mfg. Co., Inc., Orangeburg, N. Y., and Newark, Calif.*

Radiation gaging. Technical handbook on radiation gaging, claimed to be the first compre-

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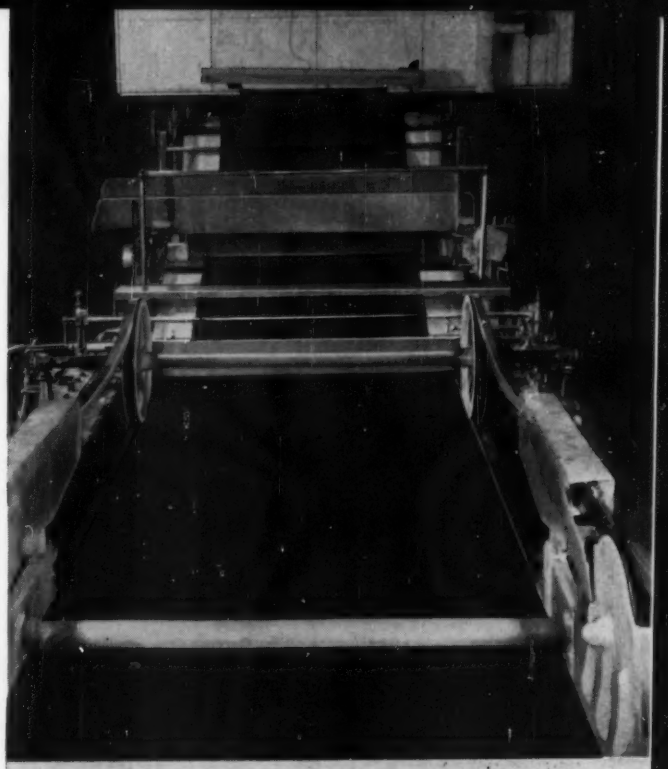

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hensive publication on the subject, presents information on gages in general, sensing units, positioning units, registering and control units, output units, special equipment and services, selecting a gaging system, and typical gage installations. 36 pages. *Tracerlab, Inc., 1601 Trapelo Rd., Waltham, Mass.*

Stabilizers. Stabilizer systems for plastisol and organosol formulations with recommended concentrations based on their general usage. 2 pages. Supplementing this is a bulletin on heat and light stabilizers for polyvinyl chloride which lists typical applications and stabilizer performance ratings. 3 pages. *Ferro Chemical Corp., Bedford, Ohio.*

"Symposium on Corona," A.S.T.M. Special Technical Publication No. 198, includes, among others, chapters of "Effects of Corona on Thermosetting Plastic Laminates" and "Corona Resistance Test Method for Laminates, Molded, and Cast Materials." Price: $1.25. 32 pages. *American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.*

Injection molding. "Plant Equipment Catalog for the Injection Molder," 1957 ed., gives prices and specifications for standard stock items of the company's own exclusive design which are ready for immediate shipment from stock. 48 pages. *Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio.*

Mold temperature control. Reprint of a technical paper on Thermolator, a process control of mold temperature, which was presented at the 1956 S.P.E. meeting in Chicago. 6 pages. *Industrial Mfg. Corp., 31 E. Georgia St., Indianapolis 4, Ind.*

Slitter-rewinders. General data and diagrammatic drawings of a number of slitter-rewinders, and pertinent data on unwind equipment. 4 pages. *Dilts Machine Works Div., The Black-Clawson Co., Inc., Fulton, N. Y.*

Mold bases, supplies. General, price, and ordering data for mold bases and plates, mold parts, tool

and mold supplies, and mold polishing and miscellaneous supplies. 170 pages. *Detroit Mold Engineering Co., 6686 E. McNichols Rd., Detroit 12, Mich.*

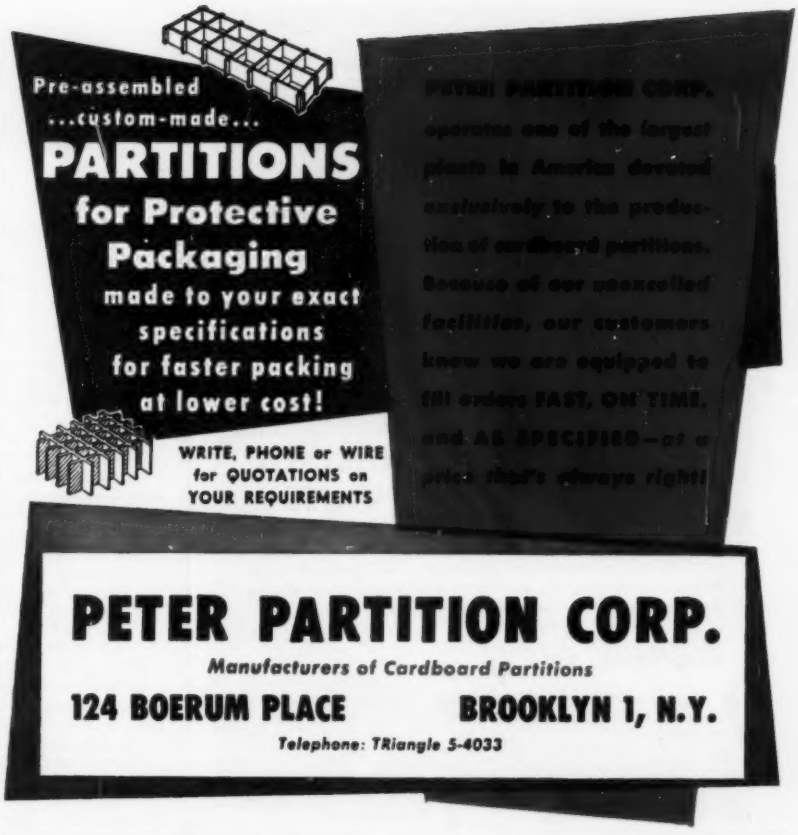
Vertical surfaces. How to apply Formica to walls with new "color blended" moldings. Form No. 735-50M-8-56. 4 pages. How to apply Formica to wall surfaces using Formica fast dry contact bond cement. Form No. 670-150M-8-56 8 pages. *Formica Corp., 4614 Spring Grove Ave., Cincinnati 32, Ohio.*

Tubing. Pricing guide for polyethylene and Teflon plastics and coated electrical tubings. Included is a selector chart for the plastics tubing which gives application data, maximum recommended operating temperatures, low-temperature brittle point, durometer hardness, dielectric strength and constant, shrinkage, moisture absorption, flammability, fungus resistance, available colors, and military specifications. 15 pages. *Irvington Div., Minnesota Mining and Mfg. Co., 6 Argyle Terrace, Irvington 11, N. J.*

Glycols. Physical and physiological properties, specifications, and applications of diethylene glycol and triethylene glycol, intermediates for resins and plasticizers. Data Booklet F-8085. 16 pages. *Carbide and Carbon Chemicals Co., 30 E. 42nd St., New York 17, N. Y.*

Epoxy pattern materials. Bulletin T-24 describes Hysol epoxy formulated resins for the fabrication of foundry pattern equipment, and some of the techniques for their use in duplicating patterns. 16 pages. *Houghton Laboratories, Inc., Olean, N. Y.*

Butyl rubber. Butyl's reaction to certain hydrocarbons, corrosive solutions, halogen gases; volume increases in Butyl rubber when immersed in many of these chemicals; and information on other factors influencing resistance, such as fillers, state of cure, cure systems, and plasticizers. Bulletin No. 102. 12 pages. *Thiokol Chemical Corp., 780 N. Clinton Ave., Trenton 7, N. J.*



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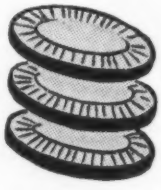

*Names on request.

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INDUSTRIAL CONTROL DIVISION

STERLING, INC.

3450 N. Holton Street • Milwaukee 12, Wisconsin

Plastics

Production and sales figures in 1000 lb.* for April and May 1957

Materials	Total p'd'n first 5 mos. of 1957‡	Total sales first 5 mos. of 1957‡
Cellulose plastics:[a]		
Cellulose acetate and mixed ester		
Sheet, under 0.003 gage	8,036	7,506
Sheets, 0.003 gage and over	7,562	7,101
All other sheets, rods, tubes	2,916	2,948
Molding, extrusion mater als	37,772	36,882
Nitrocellulose sheets, rods, tubes	1,954	1,905
Other cellulose plastics	2,394	2,028
Phenolic and other tar-acid resins:		
Molding materials[a]	79,308	75,950
Bonding and adhesive resins for:		
Laminating (except plywood)	25,725	19,725
Coated and bonded abrasives	7,941	7,335
Thermal insulation	20,641	20,269
Plywood	19,606	14,793
All other bonding uses¶	22,420	21,171
Protective-coating resins	13,434	11,106
Resins for all other uses	16,408	14,316
Urea and melamine resins:		
Textile-treating resins	16,530	15,723
Paper-treating resins	11,218	10,047
Bonding and adhesive resins for:		
Plywood	39,831	37,948
All other bonding and adhesive uses, including laminating	11,469	11,295
Protective-coating resins	15,873	11,834
Resins for all other uses, including molding	39,180	38,919
Styrene resins:		
Molding materials[a]	175,085	173,991
Protective-coating resins	36,334	34,323
Resins for all other uses	62,864	42,780
Vinyl resins, total[b]	341,562	319,954
Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for:		
Film (resin content)		40,029
Sheeting (resin content)		23,553
Molding and extrusion (resin content)		95,131
Textile and paper treating and coating (resin content)[c]		26,030
Flooring (resin content)		34,467
Protective coatings (resin content)		15,279
All other uses (resin content)		19,458
All other vinyl resins for:		
Adhesives (resin content)		16,866
All other uses (resin content)		49,165
Coumarone-indene and petroleum Polymer resin:	106,106	106,825
Polyester resins:	40,556	36,293
Polyethylene resins:	266,744	262,082
Miscellaneous:		
Molding materials[a,d]	20,229	20,068
Protective-coating resins[e]	5,551	2,691
Resins for all other uses[f]	53,862	50,073

*Dry basis designated unless otherwise specified. †Revised. ‡Partially estimated. ¶Includes friction materials. [a]Includes fillers, plasticizers, and extenders. [b]Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production

Production

From statistics compiled by the U. S. Tariff Commission

April†		May‡	
Production	*Sales*	*Production*	*Sales*
1,703	1,437	1,510	1,527
1,555	1,460	1,585	1,570
565	614	562	585
7,168	7,115	7,672	7,512
357	330	412	376
528	460	466	481
12,881	14,234	15,559	16,452
5,013	3,951	5,171	4,314
1,342	1,262	1,860	1,624
4,195	3,858	4,039	4,199
4,052	3,157	4,428	3,534
4,146	4,182	5,164	5,099
2,402	2,084	3,072	2,163
2,896	2,884	3,030	2,502
3,344	2,831	3,368	2,911
1,916	1,631	1,888	1,910
7,922	7,609	8,492	7,837
2,035	2,392	1,912	2,370
3,191	2,151	3,050	2,088
7,477	8,126	8,311	8,134
36,653	35,652	35,321	33,015
7,371	6,904	7,389	7,644
12,055	10,523	13,276	10,930
68,679	62,265	71,363	63,161
	7,036		7,641
	4,191		3,765
	18,180		18,218
	4,628		4,628
	7,890		7,519
	3,495		3,227
	4,201		4,388
	3,847		3,404
	8,797		10,371
22,174	22,406	23,586	23,856
8,961	7,595	8,525	8,393
51,793	54,555	56,170	59,504
3,825	3,905	3,731	3,638
1,067	11,553	11,940	599
11,810	10,609	11,387	9,643

are given. [c]Includes data for spreader and calendering-type resins. [d]Includes data for acrylic, nylon, and other molding materials. [e]Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins. [f]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.

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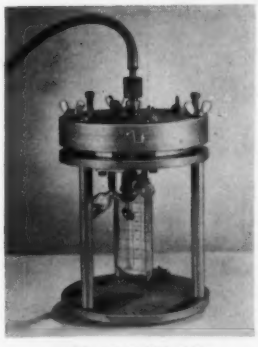

Model CS-89

This unit was developed by the Plastics Technical Service of The Dow Chemical Co. The Cell was designed to measure the gas transmission rate of plastic sheeting and plastic coated papers. The redesigned cell has the following advantages:

1. Removable cell manometer system.
2. Adapters for fast and slow gas transmission rates.
3. Vacuum Valve mounted more rigid. ASTM Designation D 1434-56T, "Tentative Method of Test for Gas Transmission Rate of Plastic Sheeting" covers this cell and the required equipment.

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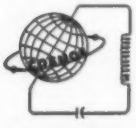

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HOW MUCH PLASTICIZER FOR VINYL?

Plasticizer production in 1956 was 416 million lb. compared to 396 million in 1955, according to the Tariff Commission's annual report on plasticizer production.

The sales figure was listed as 331 million lb. in 1956 compared to 337 million in 1955, but the sales figure is not of much value from a statistical point of view because the volume of plasticizers used by the company which manufactures them ("captive" use) is extremely high. Anyone who examines the item-by-item figures in the table on the opposite page can readily see that there are several completely unexplainable differences between production and sales volume. For example, sales may appear to be in excess of production, but this situation may be due to captive use or inventories carried over from 1955. The DOP situation is also peculiar in that production for 1956 is 8 million lb. more than in '55 but the sales figure is 6 million lb. less in '56 than in 1955.

The over-all plasticizer production increase of 20 million lb. in 1956 looks skimpy compared to the huge 96 million lb. increase in 1955, but the answer is found by comparing plasticizer growth with vinyl chloride growth; a great portion of the total volume of plasticizers is consumed in vinyl compounding.

It is difficult to tell just how much vinyl chloride (including copolymers) is produced because the Tariff Commission report statistics are difficult to reconcile when an attempt is made to separate "vinyl chloride" from "all vinyls." An estimate would place the volume at something like 530 or 540 million lb. in 1955 and around 580 or 590 million lb. in 1956. The 1954 estimate is around 400 million lb.; thus vinyl chloride production grew about 33% in 1955, but only around 10% in 1956.

Plasticizer production increased 5% in 1956 compared to a little over 30% in 1955. The fact that it did not increase 10% to correspond with the vinyl chloride increase may have been due to the use of more petroleum resin type plasticizers (sometimes called extenders) which are not all listed in the Tariff Commission statistics, or to a decline in other plasticizer uses than in vinyl or may be simply a slightly different distribution pattern in the figures reported to the Tariff Commission by plasticizer producers. One producer says that 15 or 20 million lb. of captive plasticizer was not reported and that if it were, total plasticizer production would show an increase of more than 10% over 1955.

A very rough estimate of the amount of plasticizers used for vinyl is as follows:

	1000 lb.
Tricresyl phosphate	13,000
Butyl decyl phthalate	3,900
Dicapryl phthalate	3,700
Didecyl phthalate	7,700
Diisodecyl phthalate	9,300
Di(2 ethylhexyl) phthalate	80,000
Diiso-octyl, di-*n*-octyl & mixed octyl	31,000
Octyl decyl phthalate	11,300
All other phthalates, including butyl benzyl	22,000
All other cyclic plasticizers, including certain phosphoric acid esters	20,000
Didecyl adipate	1,100
Di(2-ethylhexyl) adipate	1,100
Diiso-octyl adipate	2,200
All other adipates	4,000
Azelaic acid esters	6,000
Oleic acid esters, including epoxidized material	4,000
Phosphoric acid esters (acyclic)	3,000
Dibutyl sebacate	3,000
All other acyclic plasticizers such as citric, ricinoleic, and polymerics	25,000
TOTAL	251,300

Some of the above figures are admittedly guesses and probably the total is a few million lb. high.

Undoubtedly there are no two people in the industry who would come up with the same figures. Even the individuals in companies that handle plasticizers disagree on total volume consumed by the vinyl chloride industry. A rough rule of thumb once used was: total plasticizer needed by the industry would be about half the total vinyl resin produced—but that rule may be outmoded. For example, unplasticized vinyl is

United States production and sales of plasticizers*

Material	Production 1952	1953	1954	1955	1956	Sales 1956
	1000 lb.	1000 lb.	1000 lb.	1000 lb.	1000 lb.	$1000
GRAND TOTAL	**267,724**	**292,698**	**300,674**	**398,658**	**416,788**	**231,333**
PLASTICIZERS, CYCLIC						
Total	**194,382**	**223,810**	**227,618**	**296,294**	**315,343**	**243,856**
Phosphoric acid esters						
Tricresyl phosphate[b]	18,031	22,109	23,847	34,194	32,265	30,843
Triphenyl phosphate	5,758	7,418	6,426	8,632	8,318	—
Phthalic anhydride esters, **total**	**149,826**	**165,237**	**170,610**	**212,815**	**237,382**	**175,610**
Butyl decyl phthalate	—	—	—	1,036	3,869	4,003
Dibutyl phthalate	17,881	23,280	19,876	23,858	22,017	15,481
Dicapyrl phthalate	5,246	7,762	5,832	—	3,667	3,769
Dicyclohexyl phthalate	—	—	—	—	—	2,292
Didecyl phthalate	—	—	—	5,089	7,730	5,457
Diethyl phthalate	12,136	17,584	15,999	15,799	18,661	9,053
Diisodecyl phthalate	—	—	—	3,899	9,308	4,558
Di (2-methoxyethyl) phthalate [Di (methyl cellosolve) phthalate]	1,576	2,240	2,098	3,005	3,247	—
Dimethyl phthalate	2,901	2,508	2,557	3,950	4,037	3,474
Dioctyl phthalates, **total**	**86,987**	**84,813**	**88,224**	**102,287**	**111,681**	**81,624**
Di (2-ethylhexyl) phthalate	63,236	51,281	54,067	71,640	80,632	53,271
Diiso-octyl, di-*n*-octyl and mixed octyl phthalates	23,621	33,532	34,157	30,647	31,029	28,353
Octyl decyl phthalate	—	8,678	10,060	13,102	11,269	10,710
All others	23,227	18,372	25,964	40,810	41,916	35,189
All other cyclic plasticizers[c]	20,747	29,046	26,735	49,653	37,378	37,203
PLASTICIZERS, ACYCLIC						
Total	**73,342**	**69,888**	**73,056**	**99,762**	**101,445**	**87,877**
Adipic acid esters, **total**	**7,377**	**8,177**	**7,837**	**10,882**	**8,594**	**8,581**
Didecyl adipate	—	—	—	1,472	1,150	1,742
Di (2-ethylhexyl) adipate	3,204	3,497	2,710	2,651	1,128	1,536
Diiso-octyl adipate	1,125	1,511	884	1,592	2,218	996
All others	2,948	4,169	3,443	4,877	4,008	2,287
Azelaic acid esters	—	—	—	—	9,474	8,946
Glyceryl monoricinoleate	—	—	—	287	301	288
Oleic acid esters, **total**	**7,223**	**7,952**	**10,895**	**11,545**	**10,884**	**7,891**
Butyl oleate	—	1,372	—	1,999	1,858	393
Methyl oleate	—	—	—	811	693	—
All others	—	—	—	8,735	7,533	7,298
Phosphoric acid esters	8,911	8,534	6,122	10,412	6,565	6,785
Sebacic acid esters, **total**	**5,633**	**5,701**	**6,566**	**9,366**	**11,702**	**9,388**
Dibutyl sebacate	2,215	2,186	1,950	3,435	3,111	800
All others	3,438	3,515	4,616	5,870	8,591	8,583
Stearic acid esters, **total**	**16,299**	**4,539**	**6,488**	**8,828**	**10,598**	**10,370**
Butyl stearate	1,802	2,417	3,647	6,368	7,065	6,904
All others	14,597	2,122	2,822	3,260	3,501	3,456
Triethylene glycol di (caprylate-caprate)	—	—	—	2,031	1,440	1,335
All other acyclic plasticizers[d]	27,890	33,185	36,777	45,962	42,769	36,325

* All figures are taken from U. S. Tariff Commission reports. 1955 figures are from preliminary Tariff Comm. report.
[a] Calculated on rounded figures.
[b] Includes material produced for use as motor fuel additive.
[c] Includes data for synthetic camphor, certain phosphoric acid esters, toluenesulfonamides, tetrahydrofurfuryl oleate, and other cyclic plasticizers.
[d] Includes data for citric and acetylcitric, azelaic (except for 1956), palmitic, tartaric and ricinoleic acid esters, and for butyl myristate glyceryl and glycol esters of certain fatty acids, glyceryl tripropionate, complex polymeric materials, and other acyclic plasticizers.

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growing in volume. It is possible that nearly 50 million lb. of unplasticized vinyl was used in 1956 for sheet, pipe, and phonograph records. Only small amounts of plasticizer are used in asbestos type floor covering materials except dipropylene glycol-dibenzate since they are frequently compounded with large amounts of fillers and some of the low-cost petroleum and coal tar resin type extenders or plasticizers not accounted for in government statistics.

Compounds for film contain around 42 or 45 parts of plasticizer to 100 parts of resin but sheet generally contains a much higher percentage of plasticizer; wire coating, garden hose, and plastisol material may contain from 50 to 75% of plasticizer. Surface coating vinyl resins of the solvent type require no plasticizer for can coatings and only 10% for maintenance, tube coating, and other coating uses. Furthermore 33 million lb. of solid resin without plasticizer was exported in 1956.

With all these variables to contend with it is doubtful that anyone can give more than an approximation of how much plasticizer is used by the vinyl chloride industry. Under the old rule-of-thumb formula, some 290 million lb. of plasticizer would be required to process the approximately 580 or 590 million lb. of vinyl chloride produced in 1956. But when the estimated 80 million lb. of unplasticized vinyl is deducted and further allowance made for low plasticizer content in surface coatings and floor covering compounds, that 250 million lb. allowance for plasticizer (other than petroleum resin types) seems high. This statement is made with due cognizance of the extra high plasticizer content in plastisols and wire coating formulations.

The figures in the table indicate that DOP dioctyl phthalate is still king of the plasticizers—perhaps even more so than ever. It is generally recognized as the most satisfactory all-around plasticizer for general purpose work and when the list price was reduced to 28¢ last fall it cut heavily into other low-cost plasticizers such 27¢ butyl decyl and even 29¢ iso decyl for future delivery after present contracts have expired.

DOP and DIOP (diiso-octyl) should perhaps be considered in the same category since they are frequently interchanged and both sell for the same price. Figures indicate that DIOP has declined a bit since 1954 but producers claim that some of it is reported as DOP.

The butyl decyl mentioned above looked like a sure shot for future big volume in 1955, grew nicely in early 1956 but suffered at the hands of DOP when price of the latter was reduced. There is much talk in the trade to the effect that no one is making a profit in these low-cost plasticizers, where price competition is running rampant. Just a few years ago the price of DOP was 40¢ a pound.

Octyl decyl also declined in 1956 after giving promise of a continuous rise over the last 2 or

3 years but it commands a few cents price premium over DOP—and the supply of coconut oil from which part of it is made is also limited.

Diethyl phthalate showed a good production increase in 1956, probably reflecting the increase in cellulose acetate where shoe heels and film helped the acetate business. It is *not* used for vinyl.

"All other phthalates" is a big figure in the table but only a little over half of it or about 22 million lb. is thought to be used for vinyl chloride. That 22 million consists of butyl benzyl phthalate (Santicizer 160) and several other undefined phthalates. A big part of the plasticizers in this "all other phthalates" classification are used for pressure-sensitive adhesives.

The "all other cyclic" plasticizers classification contains little for use with vinyl other than certain phosphoric esters, some dipropylene glycoldibenzoate, the latter of which is being used in floor coverings.

Tricresyl phosphate shows an overall drop but most of the decline is due to a gradual fall off in its use with vinyl chloride, which has dropped from a high of 15 or more million lb. a few years ago to less than 13 million in 1956. Price has been 32¢ a lb. over the years, with very little fluctuation. It has reportedly given way to didecyl phthalate in wire coating where the latter's heat resistance is about as good as TCP and where the better flame resistance of TCP is not required. Didecyl is 4 to 5¢ cheaper per pound but it also has a lower specific gravity so that there is actually a 9.8¢ price spread. Butyl benzyl phthalate also moved into floor covering compounds, another formerly strong TCP application. More than half of present TCP is going into other uses than vinyl such as gasoline additives and hydraulic fluid and a sizable quantity is used for lube oil additives along with adipates and azelaics.

Adipates as a whole showed a slight decline but didecyl adipate in this group seems to be on the way up because of its good low-temperature flexibility property. It is less costly than azelaic or sebacates and is widely used in transparent vinyl auto seat covers because it does not impair clarity, it prevents brittleness at low temperatures, and it has low volatility. Plastisol producers are also finding it helpful in their various formulations. Price was reduced from 42 to 40 cents.

Oleic acid esters have not been generally used in vinyl until the past year or two, but it is believed that sizable volume is now going into the so-called epoxidized plasticizers.

Dibutyl sebacate has always been noted as a particularly good plasticizer for vinyls that require low-temperature flexibility but high price has always held back large volume use. It may be that the new iso-sebacic material now ready for market at a 42¢ price may cause considerable change in this situation and also compete with the adipates and azelaics.

The "all other acyclic plasticizers" is a big-volume figure but except for the polyester plasticizers little in this group is used with vinyl in sizable volume.

As mentioned earlier, these figures are open to challenge by anyone with sufficient proof but it is difficult to ascertain that more than 60% of all plasticizers in the Tariff Commission report are used for vinyl chloride processing. If it were possible to make an accurate separation of these complex and various classifications the percentage might drop to 50 percent.

Ruth Tulbert, treasurer of Breskin Publications, Inc., publishers of MODERN PLASTICS, died on August 6 at the age of 50 after a prolonged illness.

Ruth Tulbert

Miss Tulbert came to MODERN PLASTICS in 1939 and was named to the position of treasurer in 1953. During her association with the company she gained the respect and love of officers and employees alike. She was also active in the affairs of the Associated Business Publications and devoted unstintingly of her time and effort in work for the Lighthouse, the N. Y. Guild for the Jewish Blind, and other charitable organizations.

She is succeeded by Beatrice Grove, formerly asst. to the treasurer.

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Seven come eleven, and other games . . . *like the sporting goods story told here previously, are all part of "industry's marking requirements." They also show how Markem sees the job through, from machine to final mark. Using a standard 25A machine, with special fixtures suggested by Markem, one manufacturer is now printing one side of 15 dice at a time. Compared to leaf stamping them individually, the Markem method has cut costs and boosted output tremendously — resulting in a second machine order. A similar business is running up their score, printing game tiles 132 at a crack with a special 25A. Whether your business is games, drugs, electronics, textiles, shoes or another field — your marking problems have answers at Markem.*

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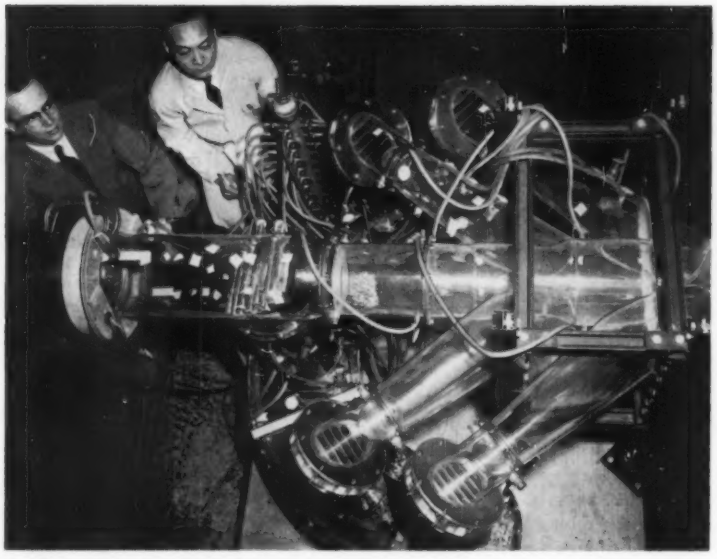

Model of water pumping station used in turbulence studies is made of acrylic tubing, uses confetti carried by air stream

Acrylic model aids design work

Confetti blown through a transparent plastic model has enabled civil engineers at the University of Michigan to reduce future operating costs on a $6 million water pumping station which the City of Detroit will soon construct and to insure keeping undesirable water turbulence to a minimum within the finished equipment.

The model, built to 1/21 scale by Cadillac Plastic & Chemical Co., Detroit, Mich., is largely made of cast acrylic tubing. Confetti carried through the tubing by a stream of air simulates the flow of water through a pumping station. By studying the paper streams through the optically clear tubing, the University engineers could detect excessive turbulence which, in normal operations, would cause pumps to handle less than their designed load. Such turbulence would also produce excessive pump vibration and wear, and cause pitting of the pump impellers.

In the course of the engineers' model study, 46 design changes were made on the pumping station, with a combined result of cutting power losses in half. This is believed to make possible savings in excess of $100,000 in projected construction and operating costs.

The changes in design were made and tested directly on the model at a fraction of the cost and time estimated for blueprint revisions.

Some of the design ideas which were tried out on the model included turning vanes, honeycomb baffles, false walls, partitions, bell mouths, floor humps, and concentric circles. The effectiveness of each individual change was measured immediately by observation of the blown confetti and by air pressure readings at various points on the model.

The model study of proposed design changes was conducted by Victor L. Streeter of the University of Michigan civil engineering department. He served as consultant to Ayres, Lewis, Norris and May, Ann Arbor, Mich., the engineering firm which has been awarded the design contract for the municipal water pumping station project.

The $6 million underground pumping station will be built in Detroit's Waterworks Park, on the main intake line from the Detroit River. On the basis of present plans, the installation is scheduled to deliver a billion gallons of water daily by 1970, which will more than double Detroit's present water supply.

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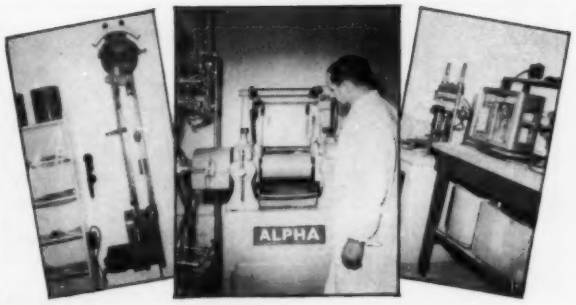

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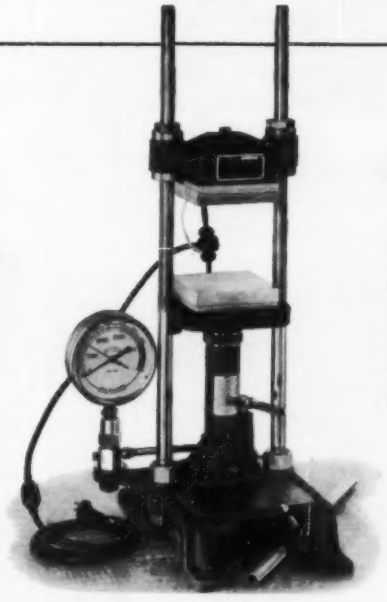

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Vinyl mask

An inexpensive mask for protection of civilians during chemical and biological warfare, developed by Johnson & Johnson, New Brunswick, N.J., is made by some intricate plastics fabrication techniques.

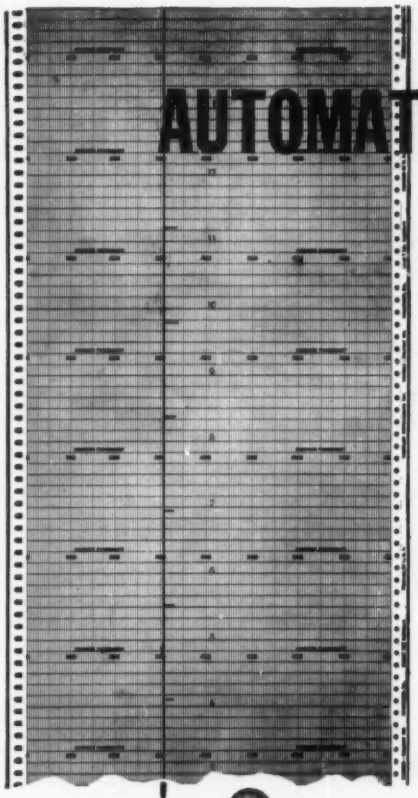
The vinyl body of the mask is injection molded around a flexible insert in the mold. The insert is a filter element which goes under the vinyl screening of the mask's face piece. This screening is part of the insert around which the rest of the mask is formed. Hot molds are used to achieve better flow, since the mask varies in thickness. Single-cavity molds are used in a 3-oz. injection machine.

The clear vinyl lenses of the mask are made from calendered material which is press-polished for clarity. In assembly, the lenses are snapped into the mask, then dielectrically heat-sealed into place.

The mask weighs only 8 oz. compared with 1 lb. 9 oz. for the conventional combat mask. Six sizes of the new mask were selected, to fit virtually every man, woman, and child in the country. Manufacturing costs are about $2. The mask is designed for one-time use.

Credits: Mask molded of Bakelite and B. F. Goodrich Chemical Co. resins.

Protective mask, one of a range of six sizes, is fitted to four-year-old by Civil Defense Warden. (Photo, Johnson & Johnson)



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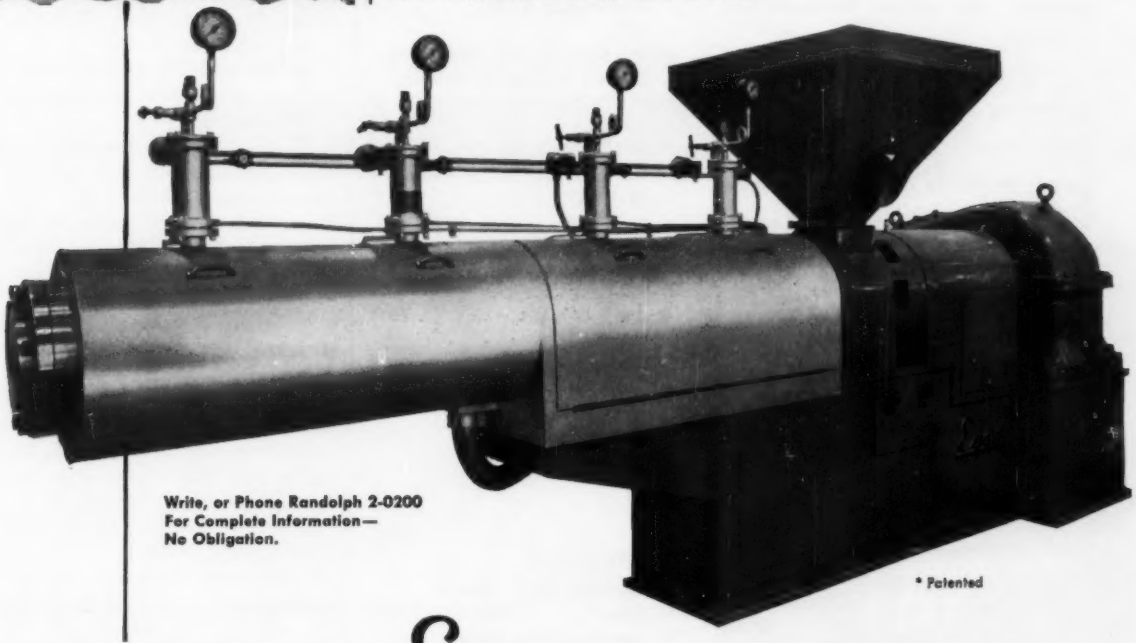
The strip chart reproduced at left shows actual material temperatures recorded during a typical day-long production run. Readings were obtained by inserting a thermocouple in the plastic melt at the output end of the extruder.



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Extruded polyester signs

Three years of exposure to Arizona desert and southern California coast environments underscore the durability of a new type plastic sign, based on polyester resins and produced by a patented extrusion method.

Developed by Maurice A. Lichten and manufactured by Grace X-ite Products, Inc., Phoenix, Ariz., the signs showed no evidence of fading, cracking, warping, or rotting after this rugged outdoor service.

These signs are described as suitable for almost any type of outdoor use. They have a mirror finish and can be made either flexible or rigid, in a continuous sheet, incorporating any design and color. Widths up to 30 in. are now being produced at 40 lineal ft./min.; the system is being geared for widths up to 6 feet. Competitive in price with enameled metal signs, the plastic units resist corrosion and denting. Integral color eliminates extra production steps and refinishing.

Montmorrilonite (natural Fuller's earth) is used as a filler for the polyester. Although production details are confidential, it can be said that the letters and designs are printed photographically. No paper is used. Pigments, filler, etc. are mineral-based. Cure is at room temperature. Finished signs are cut from the sheet by an abrasive wheel.

Credit: Laminac polyester resin, American Cyanamid Co., Plastics and Resins Div., New York, N. Y.

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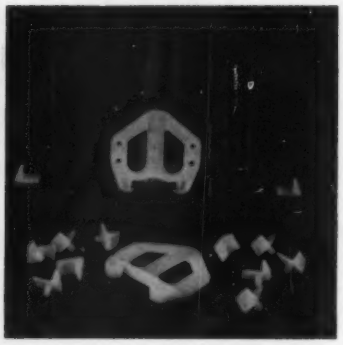
One of the first commercial applications for molded linear polyethylene is now being produced by Reiss Mfg. Co., New York, N. Y.: drawer bearings for its own line of Rway furniture as well as for distribution to other case goods manufacturers.

Two constructions are involved: a violin bridge-shaped back plate and an L-shaped corner block. The back plate, screwed to the outside back of the drawer, rides on the flanges of a metal center guide attached to the furniture frame; the corner blocks are inserted in the front of the frame and guide the drawer straight in and out. Together they provide a three-point drawer "suspension" with surprisingly smooth action.

Originally made of nylon, the pieces are now molded of Phillips' Marlex. Exhaustive tests conducted by Reiss showed that molded Marlex has about the same bearing action as nylon and an equivalent service life—at approximately half the cost. Company spokesmen believe that this application may be the forerunner of similar switches from nylon in bearings.

The suspicion that linear polyethylene could not be satisfactorily processed in molds designed for other materials was confirmed in this instance. Shrinkage was too great, and Reiss had to modify the original mold to allow for it.



Back plates and side blocks molded of linear polyethylene. Molded-in studs in blocks fit holes in furniture frame. Back plate rides on center guide

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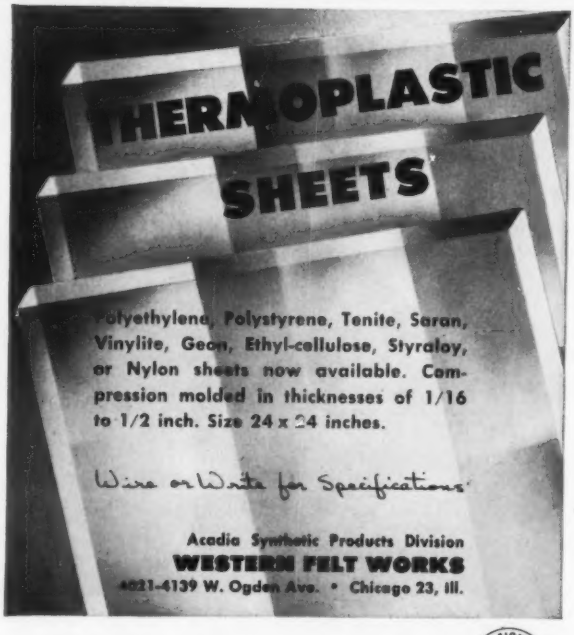
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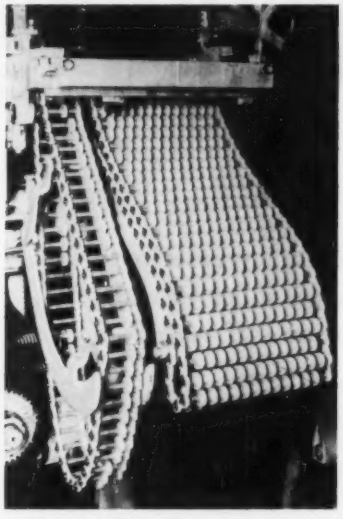
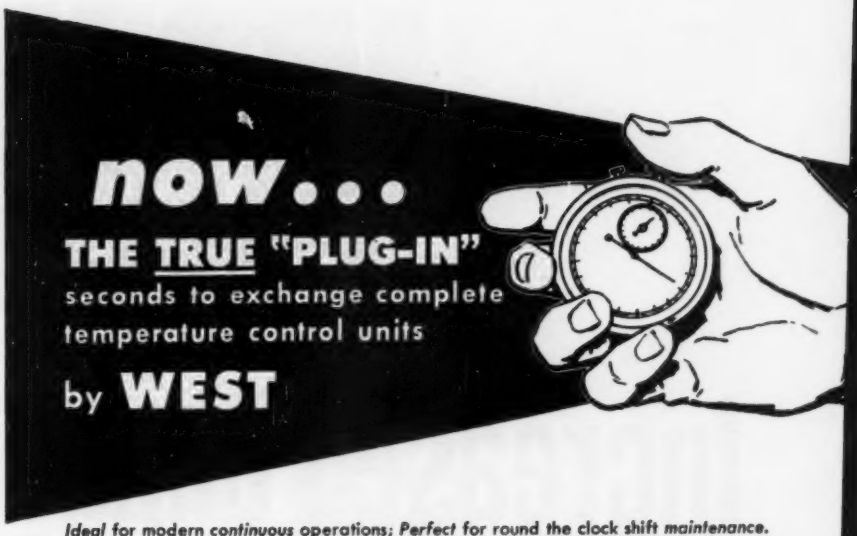


Loom pattern chain of nylon yields important weight savings, requires less power. (Photo, Bolta Products)

of getting dirt and grease on the cloth, cleaner weaverooms, and a saving on labor of oiling. Also, the nylon parts of the chain maintain their dimensional stability, reducing wear to a minimum. This eliminates skips, smashes, and other malfunctions of the loom which would result in machine downtime.

Another important feature of the nylon chain is that it permits the use of colored risers which simplifies setting up the pattern and enables the weaver to spot errors in the design almost immediately, making the whole operation more efficient.

Credits: Chain developed by H. F. Livermore Corp., Boston, Mass; parts molded of Du Pont nylon by Bolta Products Div., The General Tire & Rubber Co., Lawrence, Mass.



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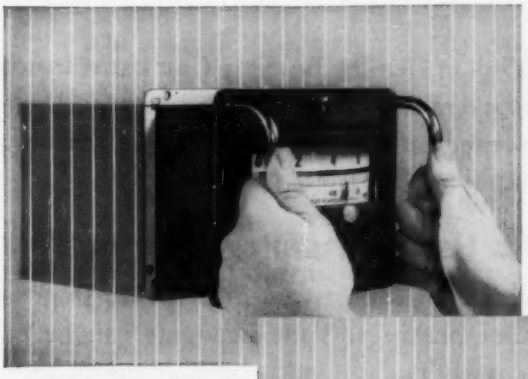

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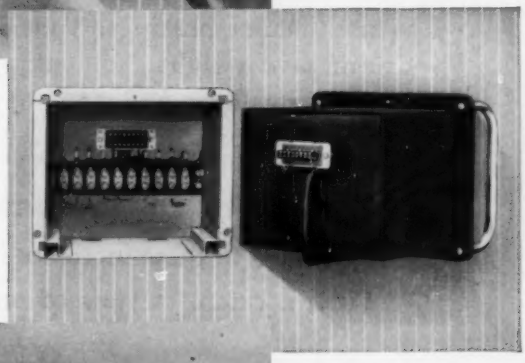

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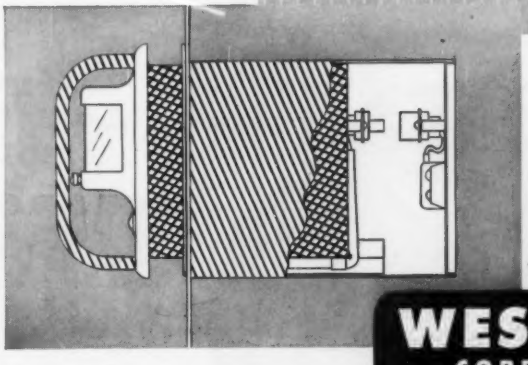

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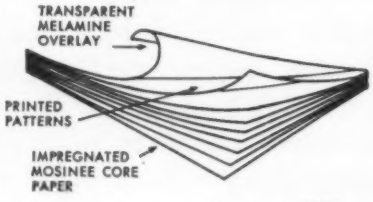

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Flexible foams

(*From pp.* 115-121)

another firm using urethane foam heavily—in the main cushions as well as structural parts—is Troy Sunshade Furniture Co., Troy, Ohio. Troy Sunshade supplies furniture to hotels, motels, restaurants, etc.

In automobiles

Though furniture and ether foam are far past the flirtation stage, Detroit is already secretly engaged to the material. While the auto industry is right now trembling in the throes of its seasonal new-model secrecy paranoia, it is evident that urethane will make a major entry in the '58 lines.

Practically all 1957 cars that carried "crash pads" use urethane (mostly ester type) in the instrument panel cover over the dash. But the big application for foam in the automobile is the seat topper pad, a 1¼- to 2½-in.-thick layer used over the seat springs. To date, these pads have been entirely foam rubber.

Chrysler Corp. will be the biggest urethane customer at the start of '58 production, with ether-type seat topper pads. This company uses a considerable quantity of the material in its '57 cars in one single, excellent application —a section of the rear seat in the De Soto and Chrysler two-door hardtops. This section, which weighs ⅔ lb., is inserted in place of conventional springs over the driveshaft tunnel. With its own springs molded integrally, the section is a load-carrying structural member. (See photo, p. 121.) The application provided the necessary support between the drive line tunnel and the top of the seat in the lowered 1957 models. No other material would do the job; foam rubber does not have the tensile strength. The seat section is molded by Reynolds Chemical Products Div., Stuebnitz-Green Corp., Ann Arbor, Mich. This company is now trying to extend the idea to encompass the whole seat.

This is the kind of application which could give urethane foam markets that foam rubber never touched, and gives credence to a

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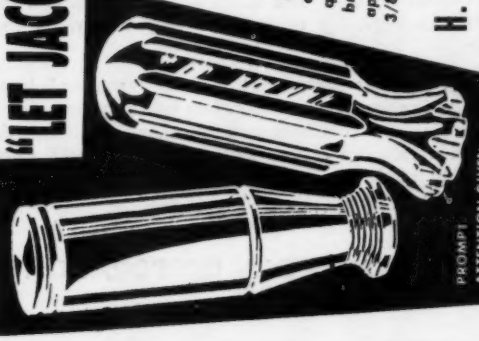

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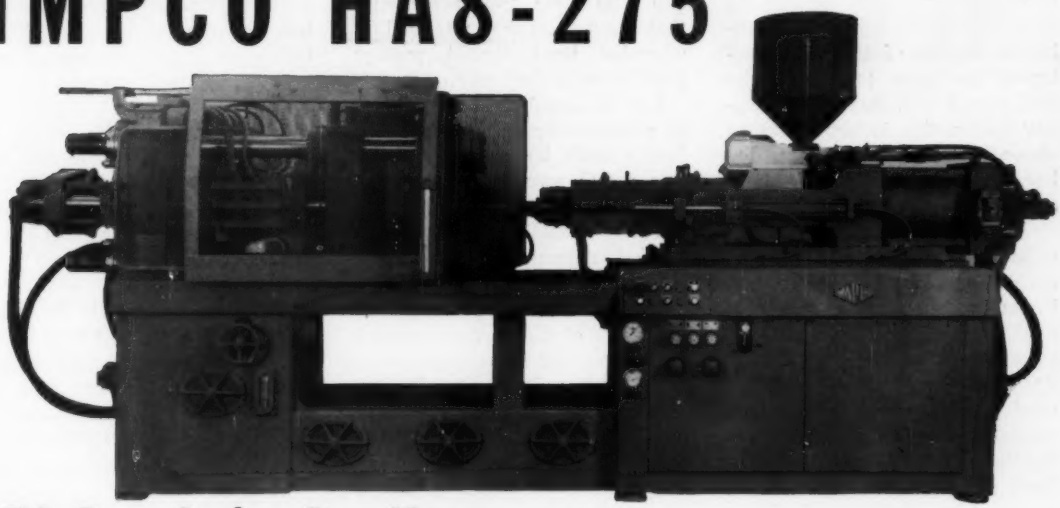

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Mobay estimate of 300 million lb. a year as the total potential market for urethane foam in cushioning—if urethane took over the field completely. Due to the density factor, this is equivalent to above 600 million lb. of foam rubber, or more than double total current sales for that material.

General Motors is also likely to be using some urethane for seat cushioning in its '58 models. Reynolds Chemical Products is now working on urethane seat topper pads for GM cars. In '57, the 75 Series Buick Roadmaster used urethane foam as a carpet underlay to give a luxury feel to the flooring. A ¾-in. layer of the foam replaced jute, though at a higher price. Some '57 Cadillacs and Oldsmobiles also used small pieces of urethane over the transmission "hump," as in the Chrysler, to provide more cushioning in a thin space than wire springs could yield.

Ford Motor Co. seems to be further away from urethane foam at the moment, but is likely to switch over during the production run. The same price advantages that are getting the material into Chrysler lines should prompt Ford to make the move.

The '58 Lincoln will up its usage of urethane by going to a much larger dash board cover which has a full sweep from door to door. With this and other applications, including a urethane-padded instrument cluster panel and padded sun visors, the Lincoln will use 30 to 35% more urethane.

Outside of the big three, Studebaker-Packard Corp., in management kinship with Curtiss-Wright, is a good bet to use big quantities of urethane foam in seats. Intensive testing has been underway, and some urethane will definitely go into the '58 lines, but the company has made no decision as yet to switch to urethane completely. Studebaker is proceeding cautiously for two reasons: it can afford less risk of displeasing a public happy with foamed rubber, and it is touchy about the supplier-customer relationship with Curtiss-Wright.

Current Detroit thinking that could push automotive consumption of foam beyond the wildest estimates is the concept of the "full depth seat" which uses solid foam. Automotive seating is "still in the dark ages," the engineers will admit, and the auto seat has remained the same 8 or 10 in. of springs, cotton, and resilient material while everything else in the car has changed. The lower styling of modern cars will soon force Detroit to save space in the seats, and the full foam seat may be no further away than the latter part of next year. Urethane, with its superior tensile and tear strength, would have even bigger advantages over rubber foam in the solid foam seat.

Garment lining

There are additional major markets for urethane foam other than cushioning. One that is already wrapped up and sold is garment interlining. A large segment of the clothing industry is presenting urethane foam lining to the public in the new fall lines. The material offers warmth with-

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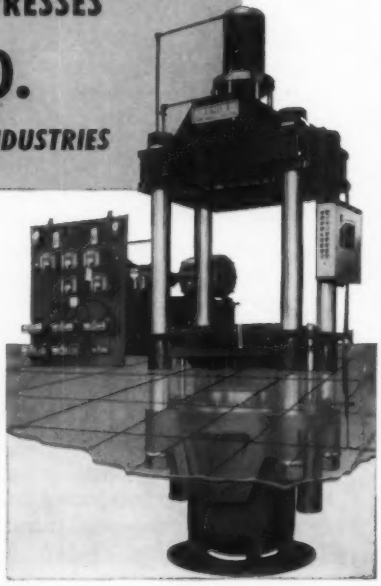

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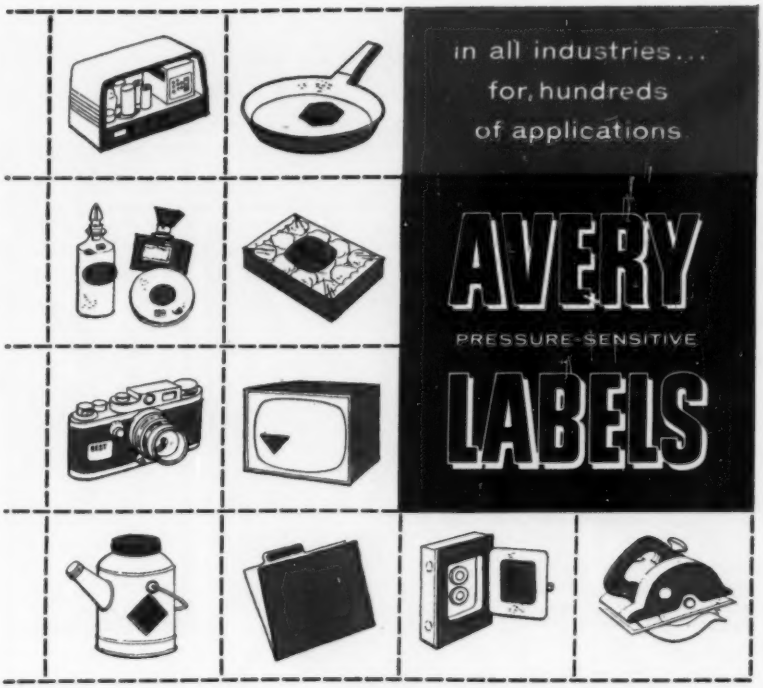
out weight; a ⅛-in. sheet with its millions of tiny air cells is equivalent in warmth retention to an oppressively heavy 16-oz. wool bat. Besides, a urethane lining stays in place and doesn't shake down or mat into lumps when the garment is washed or dry cleaned.

While the yardage in interlining is high—estimates of usage this year run upwards of a million sq. yd.—the poundage will be small unless urethane can carry a major part of the total interlining market of between 65 and 85 million sq. yards. Multiplied by ¼ lb., the average weight of a yard of interlining, the figures could become impressive.

Two more important potential markets for urethane foam are mattresses and carpet underlay. Polyester foam has had little success in either of these fields, but polyethers, with a lower price and perhaps better physical properties, may put urethane in the running again. Here the vinyl foam authorities point out that 80% of the carpeting underlay market is in commercial buildings, laid on concrete, where plasticizer migration is no factor. So they claim that vinyl foam is also in the battle on the underlay front.

Curtiss-Wright, with its specially formulated Curon ester foam, has been enjoying some penetration in carpet cushioning, even at the premium price of $2.49 a yard. The company feels that ester foams, with their "set," offer more support underfoot.

In mattresses, basic resistance to urethane comes from lack of trust of the material's aging properties. How a mattress will stand up for 20 years cannot be predicted safely from the accelerated aging test methods that have evolved so far. The Cellular Plastics Group of the Society of the Plastics Industry is doing considerable work on test methods, however, as are also numerous private concerns, and valuable data should be forthcoming soon from these sources. So far, urethane has not given any competition to foam rubber, which enjoys some 10 or 11% of the whole mattress business in the higher priced all-foam class. A strong hint of the urethane threat, however, is seen by some in the



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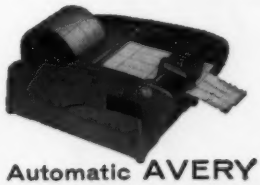

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recent price slashes on rubber mattresses by leading retailers.

At least one important bedding manufacturer today is using thin sections of urethane as a top layer over conventional coil springs to up-grade its lower priced lines. It wouldn't take too much of this practice to give urethane a bigger market than rubber foam currently enjoys, even without full-depth mattresses.

Uses for large scrap volume

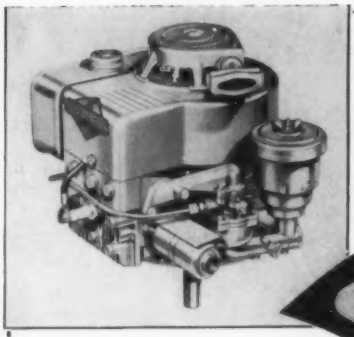
One of the problems of urethane foaming which has yet to be licked is the waste situation. Even "good" operators are running from 20 to 40% scrap—material spoiled by holes formed by gas escaping through the foam in the reaction, striations caused by improper material feed, and other defects. This high scrap rate has been somewhat responsible for the huge novelty market which has sprung up.

Prime among these items are kitchen sponges, where bad labeling is infuriating millions of housewives, because urethane is basically non-absorbent and refuses to mop a surface. On the other hand, it makes an excellent washing tool since it stays soft even when dry, unlike a cellulose sponge, lasts longer, and has more abrasion resistance.

Curtiss-Wright's Plastics Div. is also strong in the household sponge field, offering a specially foamed large-hole, sponge-like urethane under the tradename Dura-soft. The company uses labeling which tells the strong points of the foam, and how it can be "coaxed" into picking up liquids, by means of a series of pats. The O-Cell-O Div. of General Mills, Inc., is also marketing a line of sponges.

Though the novelty market is disparaged by some, it is using a growing quantity of both urethane and vinyl; some of the items stimulate more sober inventive thinking. Urethane is thought by many to be a material of "1001" uses, and some see the day when major quantities will be used in applications not even thought of today. This also applies to vinyl foam and the rigid foams.

Urethane foam holds promise in any application where insula-



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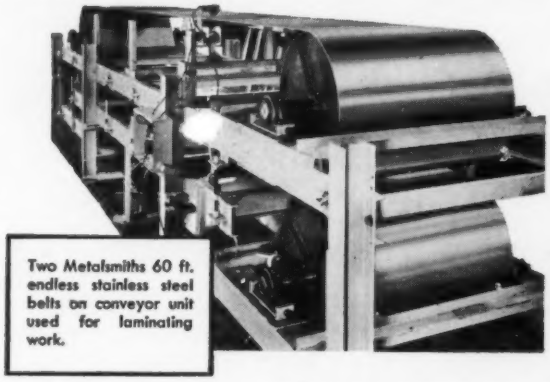

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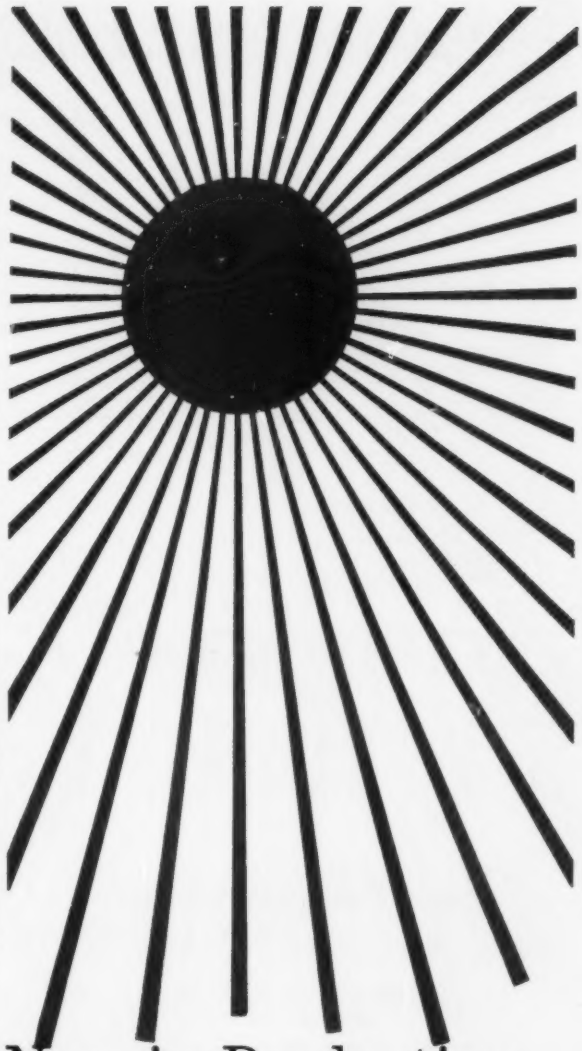

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tion, padding, or cushioning is required. For instance, the American Latex Co. is providing urethane mats for unloading large rolls of newsprint, to protect the rolls from damage. In the surgical field, a new product is urethane foam fracture padding bandage, which provides comfort under a cast. Another likely application is snap-on pipe insulation with a urethane foam core. Some fruit wholesalers are now using thin bands of flexible foam to hold "hands" of bananas together.

Fields for vinyl foam

Vinyl foam, a completely different material from urethane chemically, offers different advantages. Except for big cushions, where its heavy density makes vinyl expensive, it cannot be counted out of the running for any foam application. Also, there are good possibilities that the density of vinyl foam can be brought down in the future. The Bolta Products Div. of General Tire, Lawrence, Mass., is now manufacturing 5-lb. density foam on a commercial basis, and expects to get down to 4 lb. in the future.

Consumption of vinyl foam last year (estimated at about 3 million lb.) included considerable diversity of applications. Poundage is not expected to soar until around 1960. Broadly, vinyl has as good seating qualities as foam rubber, which is to say excellent, and it is easier to mold and heat seal than urethane. Vinyl's affinity for electronic heat sealing, either to vinyl film or to itself, almost assures it a specific market estimated at as high as 50 million pounds a year by Henry Allen, sales manager of Elastomer Chemical Corp., Newark, N. J. Elastomer was recently absorbed by Union Carbide. The company pioneered the development of mechanically-blown vinyl foam, and has licensed over 30 firms all over the world. Five producing firms in the United States are Bolta Products Div. of General Tire, Lawrence, Mass.; Federal Industries Div. of Textron American, Belleville, N.J.; Brown Rubber Co., Lafayette, Ind.; Cambridge Rubber Co., Tarreytown, Md.; and U. S. Rubber Co.

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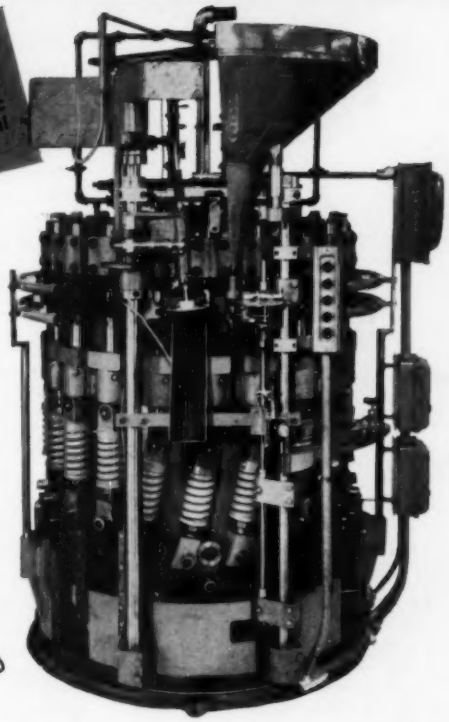

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heat sealing has found a sizeable market in furniture upholstery; in this product, a ⅜ in. layer of foam is sandwiched between a layer of vinyl film and a fabric backing. A score of furniture companies are using the material. Bolta is the big supplier.

Certainly one of the factors which has held back vinyl foam is lack of capital for development behind the operational process and at the raw materials end. Now that Elastomer Chemical has Union Carbide behind it, more rapid technological and promotional progress can be expected. Another division of the parent company, Bakelite, is, of course, most interested in the foam as one more raw material market for its vinyl.

One other method of producing vinyl foam uses chemical blowing agents. B. F. Goodrich Chemical Co., as one of the major suppliers of the resins going into vinyl foam, has done considerable study on methods.

Two firms in the chemically-blown vinyl foam field are Foam King, Inc., New York, N.Y., and Interchemical Corp., Newark, N.J. Interchemical supplies plastisols with internal blowing agents which expand under heat. The company sells vinyl foam systems used in industrial applications such as gasketing for refrigerators and air conditioners. Foam of about 12 lb. density is sprayed in place with simple equipment.

Other automotive uses

Vinyl's moldability has helped it to win some automotive applications, such as on the "jump" seat in the 1957 Checker taxicabs, which represented a sizeable production run for Brown Rubber Co. Seven-pound-density material was used for the thin cushions. Safety sun visors of vinyl foam were used by Chrysler and Lincoln last year, and the new Edsel manufactured by Ford Motor is using a padded horn ring molded of vinyl foam by Dryden Rubber. In many automotive applications, such as arm rests, sun visors, and even door or roof-lining material, vinyl will compete application-for-application with urethane. The same applies to furniture.

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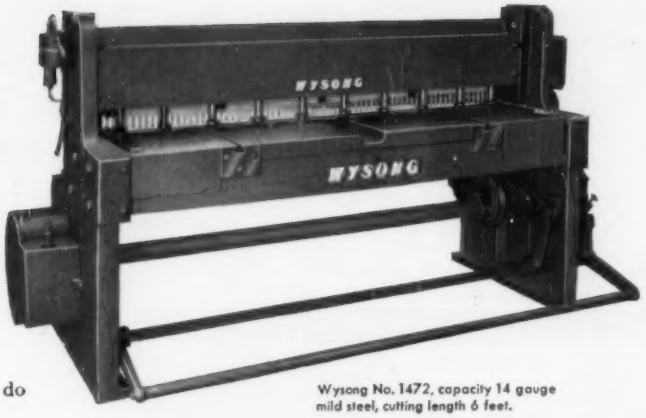

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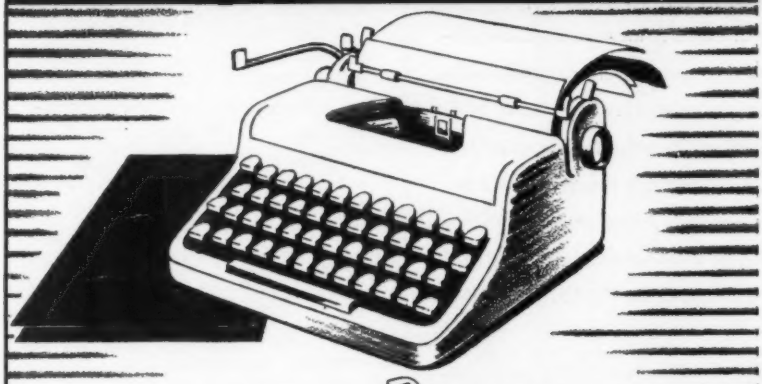

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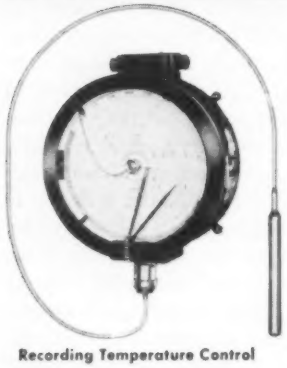

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Louis, Mo., is now producing some 2400 molded vinyl cushions per day for the company's line of kitchen and dinette furniture. The equipment used for this molding job was developed by Dennis Chemical Corp., St. Louis, Mo. Dennis is a supplier of plastisols, and since these are used to make vinyl foam, the diversification was a natural step. The firm's machine is called the Fay Foamer. (See "Vinyl foam by countercurrent absorption," by George J. Crowdes, Jr., MODERN PLASTICS, 34, 117, July 1957.) Main advantage is said to be more uniform cell structure, though this statement would be argued heatedly by backers of the other processes. Vinyl foam seems to be in the same conversationally taboo class as politics and religion; it's almost impossible to discuss the subject without getting into a violent argument.

Rigid Foams. **A second article on foams, scheduled for Oct. MPL, will cover the rigids, with emphasis on present status and future possibilities.**

Actually, whether urethane or vinyl—or foamed rubber—wind up on top of the foam market in the next 10 years is of little importance to laymen with little or no commercial interest in materials.

What is important is that the foams, taken together, offer an intriguing challenge to the imagination of businessmen and design engineers everywhere. The result of the current battle will be better products, less expensive products, and new products undreamed of today.

Background

Those readers who wish to obtain more technical background on plastics foams—materials, processing, and fabrication—are referred to the section "Foamed Plastics" which starts on p. 334 of the 1957 MODERN PLASTICS Encyclopedia Issue, to be published in mid-September, 1957. Also to the Foamed Plastics Chart, p. 556 of the same volume.—END

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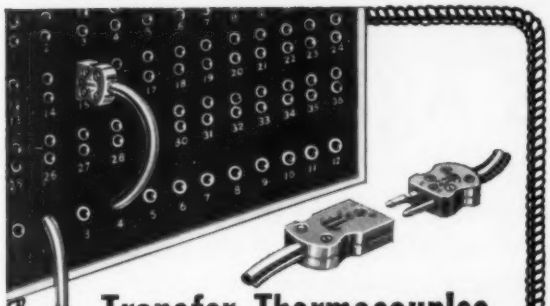

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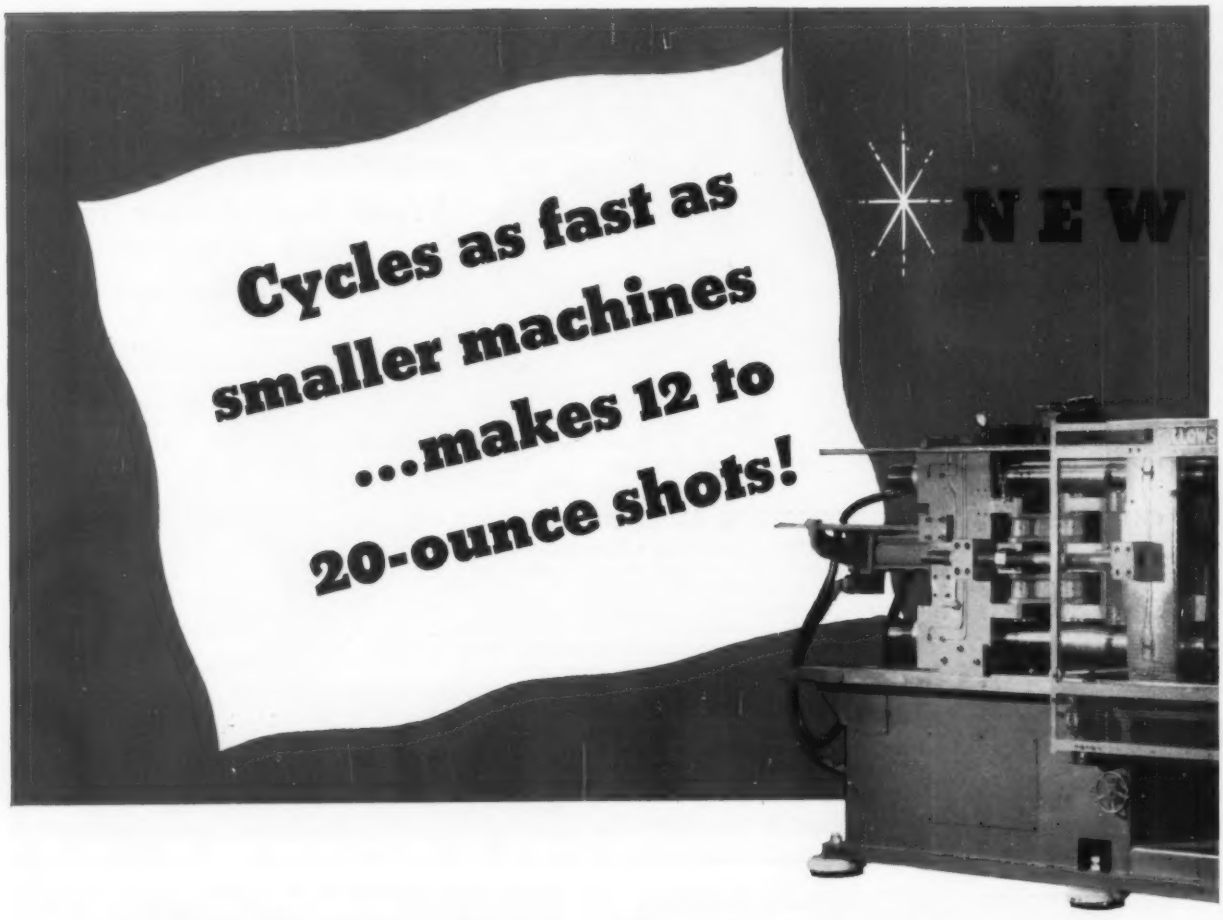

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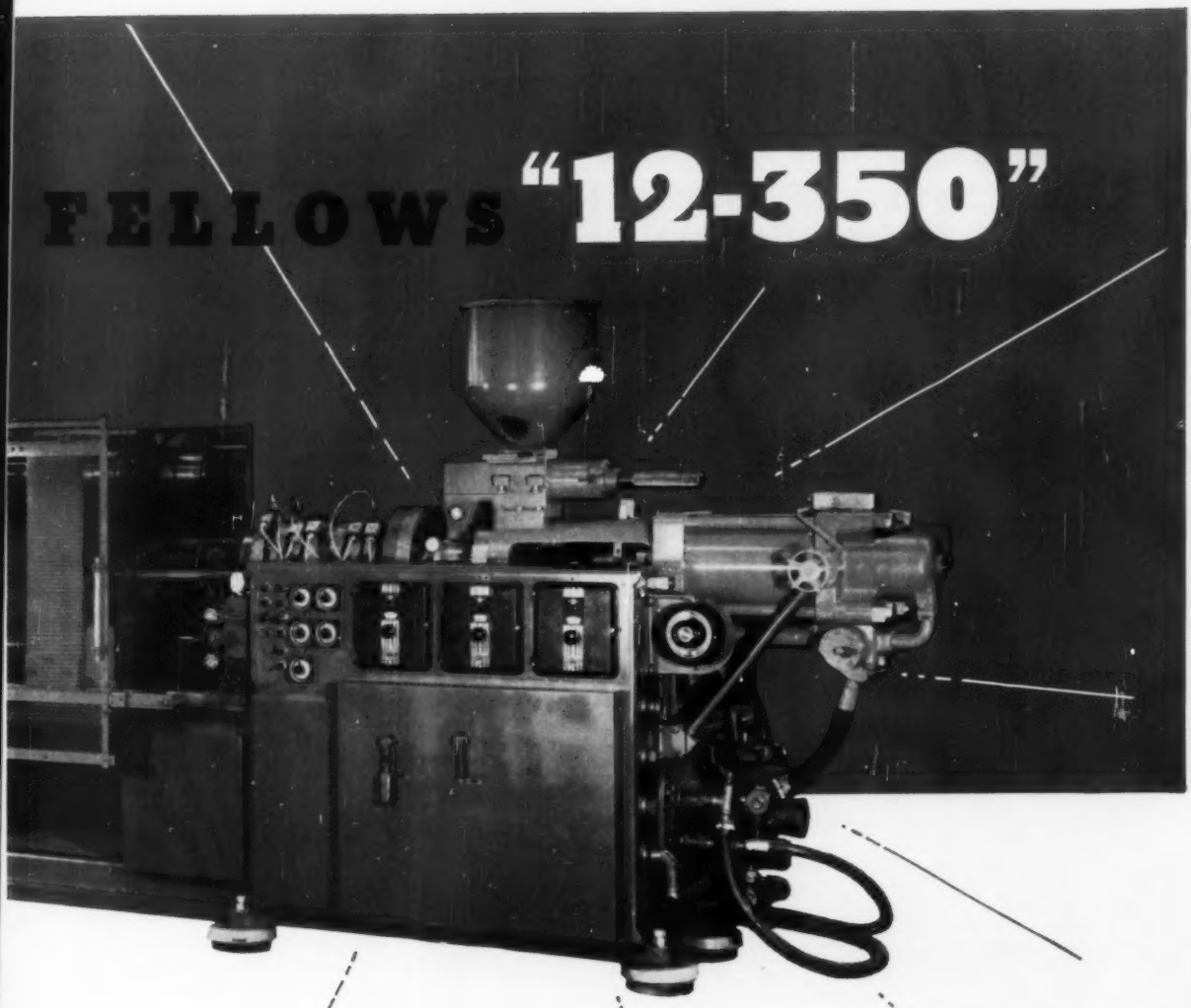

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The Schlitztap

(*From pp.* 122-125)

operation of the movable core pin, and a number of other important aspects of the actual production operation.

Among early difficulties faced were the appearance of bubbles on the decorated surface, mottling of colors, and fading or "burning out" of the colors in the design. The latter problem was particularly serious with pastels. Late in November 1956, the molder had substantially overcome such obstacles and, by developing a technique never before used, presented Schlitz with a number of sample parts which won the company's approval.

Both the handle collar and the color band are produced in four-cavity transfer molds. The base of the color band is recessed to provide an interlocking union with the stepped end of the collar. No decoration is applied to either of these components.

Most of the production problems were presented by the upper, decorated section of the handle, which measures 5½ in. tall, has a maximum diameter of approximately 2 3/16 in., a maximum wall section of more than ¼ in., and weighs just under 6 ounces. This part is produced in a single-cavity mold run on a 170-ton transfer press. Two oblong preforms, electronically preheated, are placed in the transfer chamber for each shot.

Two distinct molding cycle phases

There are two distinct phases to the molding cycle. During the initial phase, the transfer plunger forces the melamine material into the closed mold and the part is allowed to pre-cure until it will hold its shape without the support of the mold. As the next step in the process, the press is opened momentarily.

At this point, the press operator places the two melamine foil overlays in position—one above the handle and the other below, with the printed portion facing the molded part. The press then is closed again and the curing cycle is completed. During this period the printed overlay is fused per-

manently into the surface of the handle, with the design protected by a transparent layer of pure melamine.

At the end of the cycle, it is necessary only to finish the part at the parting line.

In order to prevent possible color contamination, presses used in molding the Schlitztap melamine parts are surrounded by an enclosure.

Assembly of parts into completed handles

The molded melamine parts, delivered to Hammer Bros., are assembled into the completed tap handles by placing them on the threaded aluminum rods. The pressure of the anodized aluminum crown and shank which are screwed on the top and bottom of the rod holds all the sections securely together.

Installing the handle is merely a simple process of screwing the internally threaded metal shank onto the beer tap control fitting. If necessary, the pattern of the molded plastic section can be oriented by loosening the crown slightly, rotating the part, and then re-tightening the crown.

In addition to its beauty, the handle is virtually impossible to scratch, break, or chip in ordinary use.

The colorful design, with its protective overlay of fused melamine, is immune to staining, perspiration, or discoloration. Years from now, the Schlitztap should be as attractive as when it was installed.

Although the new decorative tap handles are still in limited distribution, Schlitz reports that favorable increases in draught beer sales have been recorded in outlets installing them. Placed in flannel drawstring bags and packed in individual white set-up boxes, the handles are brought to the retail draught beer outlet by the Schlitz wholesaler. Used as one element of an elaborate draught beer kit which includes flip charts, assorted special literature, and a handsome thermometer for the draught beer precooler, the Schlitztap is expected to play an important part in winning new accounts for Schlitz throughout the country.—END

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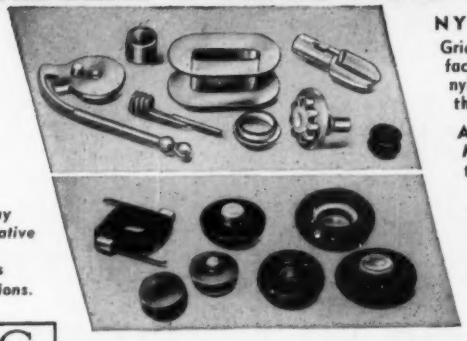

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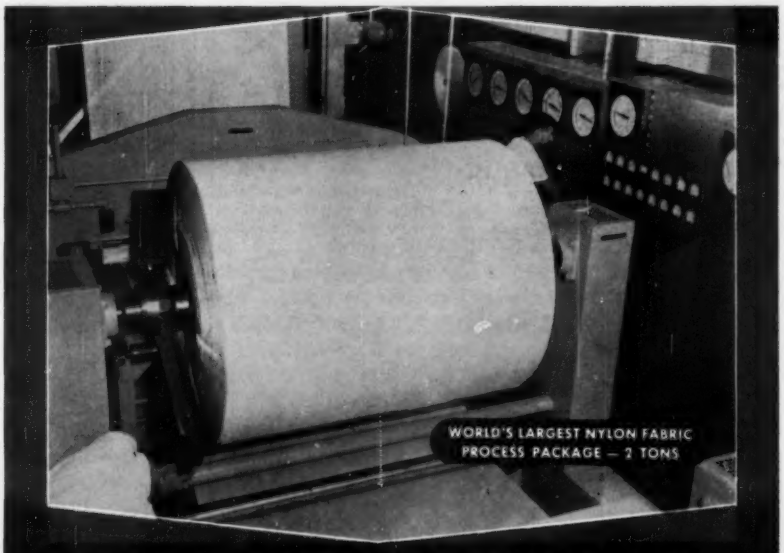

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Which epoxy?

(*From pp.* 128-132)

surfaces must be built up and machined off flush with surrounding areas to cut down turbulence and drag. These same materials are used as body solders in automobile body repairs and marine applications. Epoxy resin compounds of this type, in addition to being very adhesive, are resistant to sea water and weather exposure and form an excellent base for paints.

Foundry cements. Metal-filled epoxy pastes are useful in the pattern shop to make changes in metal, plastic, or wood patterns. They can be applied to surface defects in metal castings to salvage parts which would ordinarily be scrapped. The adhesion of these materials and their free machining qualities make possible repairs to castings which must later be accurately machined by any conventional method. The metallic content of most of these formulations is not sufficient to make plating practical.

Pipe joints. Paste-type compounds find some use as pipe thread cements where threaded joints are desired which cannot be taken apart. They are also used to caulk bell and spigot joints on cast iron, ceramic, and concrete pipe.

Miscellaneous. Paste-type formulations with non-metallic fillers have been used successfully to line concrete (and metal) pipe to prevent erosion from sea water and other corrosive liquids. Similar materials make excellent repairs in concrete floors, walks, and other concrete surfaces.

Special packaging. Metal-filled epoxy pastes and the hardener to be used with them are now available in self-metering tubes. Proportioning is accomplished by squeezing a length of the resin mix and an equal length of the hardener mix, then mixing and applying.

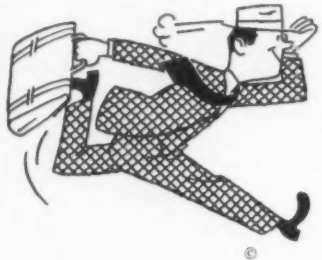
Maintenance and repair kits

For industrial and home repair, kits are available containing resin, hardener, glass cloth, and measuring cups to make possible on-the-spot repairs to corroded tanks, piping, automobile bodies, damaged metal housings, boat hulls, etc.

Swatches of glass cloth are saturated with catalyzed resin, then applied to the areas to be repaired. The outstanding adhesive properties of the epoxy make possible durable reinforced repairs which are strong and have good chemical resistance. Applied over glass piping used in chemical apparatus, these laminated applications strengthen the glass, making it less vulnerable to breakage, and, in addition, provide protection to personnel in the event of failure.

Epoxy resins have indeed proved time and time again their value to the fields of protective coatings, adhesives and cements, plastic tooling, and electrical insulation.

Taking all their merits into consideration, it would surely not be amiss to say that the most outstanding is their complete versatility.—END



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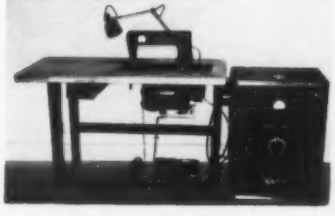

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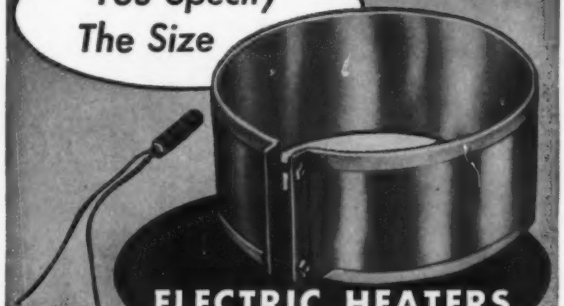

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maintain quality, precision and high output of "PLASTIMODE" plastic extrusions for

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DIVISION OF MONADNOCK MILLS

Plastic Process Company in Los Angeles, a division of Monadnock Mills, extrudes every type of thermoplastics in a wide range of sizes and shapes from monofilaments to sheet stock, tubing, rods, strips, etc. To meet the wide demand for their precision "Plastimode" custom extrusions, they operate their NRM Extruders on an around-the-clock basis. The photo shows fluorescent fixture shields being produced on NRM Extruders in a part of the Company's busy plant.

It pleases us to know that the dependability and high performance of NRM Extruders contribute importantly to the trade success of "Plastimode" products. We know, too, that Plastic Process Company's experience of "top quality, precision extrusions on a high output basis," is the typical experience of NRM users everywhere.

If you are planning to purchase plastics extruding equipment, it will pay you to check the many profit-making design and operating advantages of *NRM* Extruders and Accessories. Compare the time-saving features, the low operating cost and the high pounds per hour rates with any other extruder made, and you'll see why it's more profitable to "go NRM."

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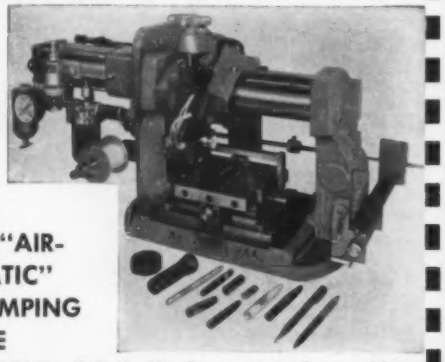

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The ACROMARK No. 9AH Machine has compensating provisions for variations and it may be provided for fully or partially automatic operation. The ACROMARK "line-contact" principle of marking is fully utilized in this machine to insure perfect marking in any desired color at marking speeds up to 1500 or more parts per hour depending upon the size and material.

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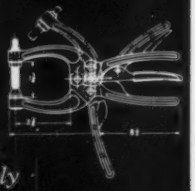
Trigger-Release levers also available on DE-STA-CO Toggle Clamp Models 461, 462-S, 463, and 463-S (jaw spans ranging from ½" to 3").



For a one-handed clamping job . . . ecpecially in a hard-to-get-at place . . . there's *nothing, absolutely nothing*, as good as a Trigger-Release DE-STA-CO Portable Clamp! . . . And now, with 5 more new models, we meet practically every such clamping requirement.

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DE-STA-CO DETROIT STAMPING COMPANY
WORLD'S FIRST LINE OF TOGGLE CLAMPS
327 Midland Avenue • Detroit 3, Michigan

Permanent plants

(*From pp.* 133-136)

amount of money which the purchaser is willing to spend. In order to stimulate interest in proper handling of the plastic plants, Kendra Studios employs a traveling representative who puts on demonstrations at department stores and other retail outlets.

Do-it-yourself kits

An interesting new development in the field of artificial plants made from vinyl plastisol is the do-it-yourself kit, by means of which consumers may make and assemble their own realistic plastic foliage. Kits of this type are now being marketed by Popeil Bros. and have created wide consumer interest. Sold at a nominal cost through department stores, variety stores, and other retail outlets, they are actively merchandised through store demonstrations which dramatize how easily the average consumer can now make her own life-like, long-lasting plastic plants.

Included in the Popeil "Tropic-Green" do-it-yourself kits are several leaf molds stamped from sheet aluminum, collapsible tubes of vinyl plastisol in various colors, lengths of wire to form ribs and stems for the plants, and a supply of pressure-sensitive tape for assembly. Also available as re-order items are some 21 types of leaf molds ranging from a 3 by 1¼ in. amaryllis to a 5 by 10 in. caladium leaf, extra tubes of plastisol in seven colors, and wire and tape.

Complete instructions included with each kit explain how to place the supporting wires in the molds, fill the molds with one or more colors of the vinyl material, and cure it by using a heat lamp, oven, electric broiler, or top of range as a source of heat. Leaves are said to be fully cured when glossy—usually within a minute or two. Molds are allowed to cool before stripping leaves from them.

Polyethylene foliage

Although vinyl plastisol is the dominant material now being used in the production of plastics plants, there is also some application of polyethylene for this type of work. Stanley Bernstein, Bronx, N.Y., fabricates a variety of plants from 22-gage polyethylene extruded sheet.

Bernstein's process is a combination of silk screening the transluscent sheet, then cutting the leaves out and vacuum forming them in zinc molds. The stems, which are polyethylene tubes over wire, are heat-sealed to the leaves and tape is used to bind groups of leaves together.

One of the important secrets of the Bernstein process is in the silk screen inks which, in the vacuum forming process, develop a natural gloss. By selection of inks he claims to be able to predetermine six different grades of gloss in the finished foliage.

Polyetheylene plants and flowers having injection molded leaves and petal components which are assembled on plastic-covered wire stems, are being produced in France, in Italy, and in Japan. As compared to vinyl plastisol plants, these units have a much

increasing production
efficiency everywhere . .

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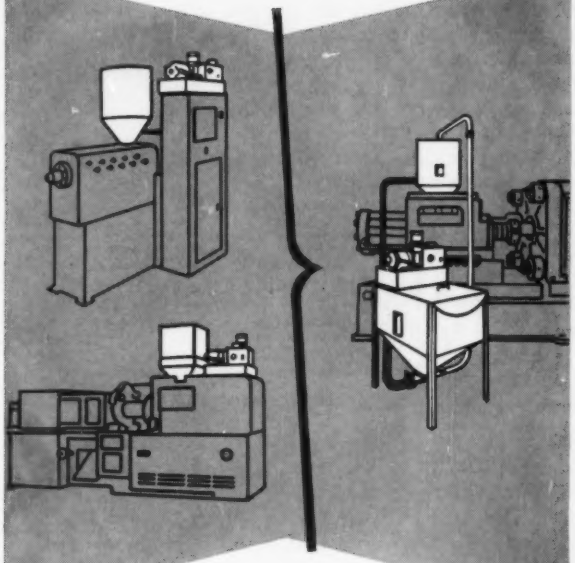
NEW combination
Automatic Jet
HOPPER LOADER



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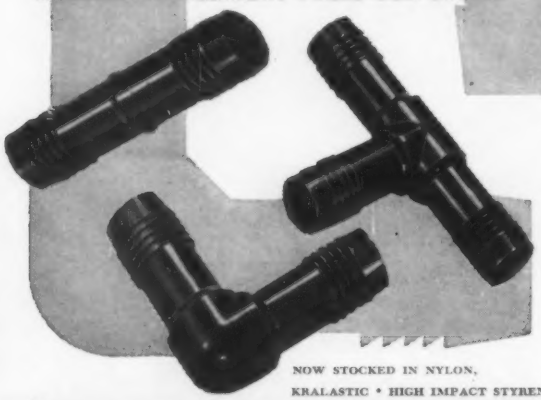

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Set the time cycles, speeds, temperature—and maximum efficiency is yours with even unskilled operators.

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stiffer feel and appearance. With injection molding, color variations and particularly variegated effects are difficult to achieve because each hue calls for a separate molded component or subsequent hand decoration of the finished plant. Also, the injection molding method involves costly tooling if many plant sizes and varieties are required. This technique apparently has not been adopted by U. S. producers of plastics plants.

Rotational molded fruits

Among the newest products introduced by Kendra is a line of vinyl plastisol fruits which for sheer realism surpass anything previously accomplished with such materials as wax, papier-mache or glass. Included in the Kendra lineup of fruits are apples, bananas, peaches, lemons, oranges, grapes, and pears. Under development are pineapples and strawberries.

Although detailed information on the production of these fruits is not presently available, they are produced of specially formulated vinyl plastisols, using rotational molding equipment similar to that employed in the manufacture of hollow plastic items ranging from dolls and play balls to duck decoys (See "More bounce in vinyl balls," MODERN PLASTICS *34*, 96, Sept. 1954). In molding these realistic plastic fruits, which are colorfast, washable, and guaranteed non-breakable, liquid plastisol of the correct base color is poured into the mold cavities, which are then secured shut. Durthe molding process, the molds are continuously rotated as they move through the oven section of the molding equipment, causing the plastisol to cure in contact with the inner walls of the mold and producing hollow, one-piece items. Upon removal from the mold, the fruits are hand-finished for the final touch of realism; on bananas, for example, small touches of brown heighten the illusion of actual fruit. Peaches receive a coating of flocking almost impossible to distinguish from real fuzz.

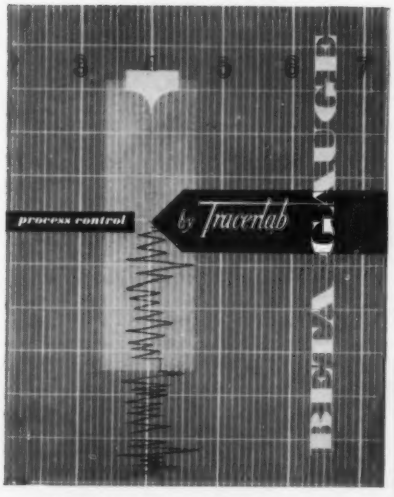
Marlo Studios, currently doing development work on such plastisol fruits, is considering the use of additives to the liquid plastisol which will impart an authentic fruit odor to these products. Excellent results have already been obtained with lemons and with vinyl plastisol lemon leaves.

All in all, the production of artificial foliage, flowers, and fruits represents an active and growing market for selected plastics—particularly vinyl plastisols tailored to specifications. In view of the excellent progress made to date, and the growing popularity of these products with both commercial and domestic consumers, more and more plastic plants can be expected to appear in the nation's flower pots and planter boxes.

Credits: Vinyl plastisol compounds for Popeil Bros. and Marlo Studios from Reslac Chemical Div., Borden Co., Chicago, Ill. Polyethylene sheet used by Bernstein from Visking Corp., Chicago, Ill. Rotational molding equipment, Akron Presform Mold Co., Cuyahoga Falls, Ohio.

Tracerlab

offers industry's first complete handbook on radiation gauges



Available for the first time — a complete non-technical explanation of how this modern production tool works to help you reduce waste and improve output and quality. It covers types of gauges and gauge components for a variety of applications in thickness measurement and automatic process control. Your copy is registered and automatically kept up to date to keep pace with changing technologies.

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Braille in acetate

(*From p.* 143)

has developed the Braille Former, which can be described simply as a table-top vacuum forming machine. A cellulose acetate sheet is locked in a frame, heated, and then drawn by vacuum over a paper Braille "master." The result is a plastic sheet with the raised Braille dots permanently impressed.

But if the performance is conventional, the design, and the difficulties encountered are not. One of the biggest problems was developing a satisfactory heating oven that could operate on household circuits—120 v. and less than 2000 w.—and still be capable of providing heat over a full page of Braille.

Infra-red heater used

An oven that could provide uniform heat over a 10- by 10-in. frame was finally built, using custom-made infra-red glass-tube heater units which were supplied by Corona Electric Co., Van Nuys, Calif.

The design philosophy, calling for absolute simplicity, economy, and ease of operation, is reflected throughout the Braille Former. To operate the machine, the operator places a sheet of Braille, either an imprinted page or one that has been hand-blocked in heavy paper, on the manifold. Over this he places an acetate sheet and clamps it down with a simple aluminum frame.

The operator then "cocks" an automatic timer and at the same time pulls the oven forward over the plastic sheet. This trips a Microswitch that starts the timer and the heater. When the timer has run out (it is usually set for about 8 sec.), a second Microswitch turns on a 1.6-hp. motor and vacuum pump. A red signal light or buzzer indicates that the sheet has been formed. Virtually any thermoplastic sheet or film can be used with the machine, but a matte-finished acetate appears to provide the best "feel."

The Braille Former was designed to sell for approximately $350, complete. It is estimated that 300 to 500 will be ordered by foundations alone.—END

NEW ECONOMY TIP

plastic "sandwiches" with UNION HONEYCOMB kraft cores

Union HONEYCOMB sandwich core is as practical and versatile a material today as plastics themselves. Reason? This expanded cellular paper core, laminated between plastic sheets or "skins", is one of the strongest structures known for a wide variety of applications. And on a square foot basis—the most economical.

The lightweight, fewer component parts of Union HONEYCOMB save you shipping expense — speed fabrication—lower labor costs.

Table and desk tops, panels and doors—any comparable product—HONEYCOMB sandwich core can help you manufacture them faster, and more economically.

Put Union HONEYCOMB's advantages to work for you as have many leading fabricators. Write for new booklet today.

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Send me new illustrated booklet on uses and advantages of Union HONEYCOMB.

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Alphabets in stock

(*From pp.* 140-142)

is desired. Gypsum, Masonite die stock, and cast phenolics and epoxies are also used to make molds.

Installation advantages

The installation of plastic letters is simplified by their light weight, which keeps structural support requirements to a minimum. The weight factor also allows for a high degree of versatility in mounting methods.

For unlighted building signs, the basic mounting technique involves pads which stand out from the backs of the letters for attachment to walls with adhesive. The pads contain holes through which the adhesive oozes, creating many small "rivets." For cementing acrylic letters to an acrylic background of contrasting color, a popular method of making signs, ethylene dichloride is used as a solvent cement.

The free-standing method of mounting letters creates good visual impact, especially on low buildings. In this case, a strip of plastic is used at the bottom of the letter for fastening to a roof or the edge of a marquee. If the letters are exposed to the wind on all sides, metal rods give additional support.

Stud mounts are used for holding letters where there is access to the sign from the rear. The mount consists of a tube of plastic threaded to receive a bolt. Letters are supplied with three or four of these mounts, and the method is excellent for attaching names and advertising messages to truck and trailer bodies. Polyplastic Forms, Inc., a large Brooklyn, N.Y., supplier of acrylic letters, says the cost of plastic compares favorably with wood and even painted letters in this application, and that the plastic is much more durable, attractive, and easier to maintain. (Polyplastic Forms supplied the letters used in the title of this article.)

For fastening letters lighted by neon tubes, angle brackets and various clips of plastic or metal are used, which permit a choice of standout distances. On small letters or large letters of shallow depth, where there is not enough room to conceal neon tubing inside the channel of the letter, the light source is placed behind a background, and flanged letters are used. The background is cut out to receive the letters, which are pushed through from the rear. The flange method is also used in attaching letters to the fabric of awnings and canopies. This application of plastics letters makes good use of their light transparency; daylight makes the letters bright by day and the incidental lighting of a store window or marquee keeps them effective at night.

Though a relative newcomer to the sign letter field, plastics have come a long way fast and the pace is still accelerating. Virtually unknown in the sign field until after World War II, plastics consumption by sign men is now running above 10 million lb. a year, according to *Signs of the Times*, an industry publication.—END

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This system represents considerable reduction in initial and maintenance costs by eliminating the expensive, space-consuming accumulator while retaining its desirable features.

The hydraulic circuit is so designed that pressure is maintained in six presses while the seventh is opening or closing. Automatic cycle control of each press is by pushbutton and adjustable timer.

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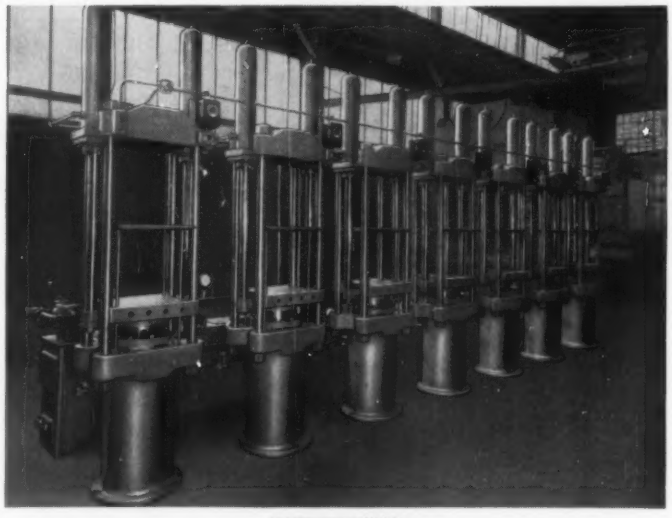

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PRESSES • BULLDOZERS • BENDERS • PUNCHES • SHEARS

Rotary file

(*From p.* 137)

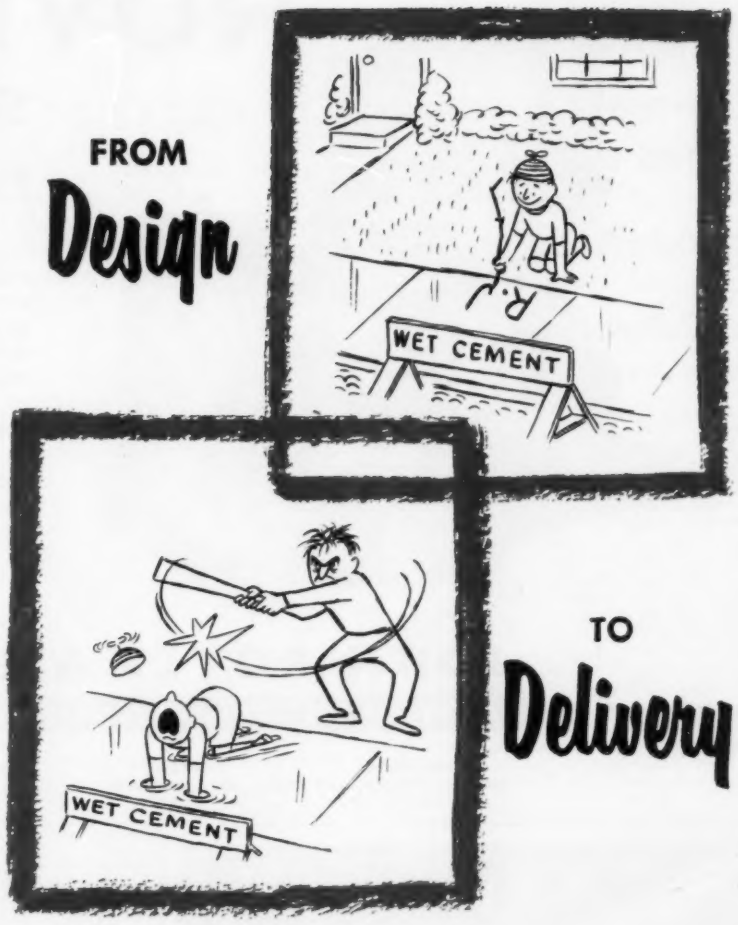
being offered through the pages of the magazine at $5.95.

The six injection molded components comprising the cook book are shown in an accompanying illustration. Top and bottom sections of the outer housing, sized so that the cover recesses snugly into the matching base, are produced in single-cavity molds on a 12-oz. injection machine. The knob and spindle components, made in a four-cavity family mold, are run on an 8-oz. machine. Air operated side cores in this mold produce the deep cores in the two tubular spindle parts. The spindle halves, on which the card-holding rings are integrally molded, are made with a lap joint at the mating ends so they can be solvent-cemented into a finished shaft.

The molder, who also handles subsequent assembly operations on this unusual kitchen aid, cements the two parts of the spindle together and snaps it into position with the outer ends inserted in openings cored in the extended sides of the housing base and cover. The knobs are then cemented to the ends of the spindle. The top section of the housing, designed with a lift-up ledge along the front, is balanced so that it remains in the closed position, yet may be lifted and tipped back at a touch until it hits stops molded inside the base.

After the cards have been mounted in the book by a printing firm, the finished units are ready for mailing in a sturdy self-shipper corrugated container which assures safe arrival. Blank cards, available from *Household*, may be used by the housewife for mounting additional recipes. In addition to its primary use as a recipe repository, the new rotary file has many potential applications in offices, libraries, etc., where it is desirable to provide quick, convenient access to a large number of names, addresses, or other information.

Credits: Household Hi-Speed Cook Book molded by Service Plastics, Inc., Chicago, Ill., using Dow 475 impact styrene material dry-colored in the molding plant.



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THE WATERTOWN MANUFACTURING CO.
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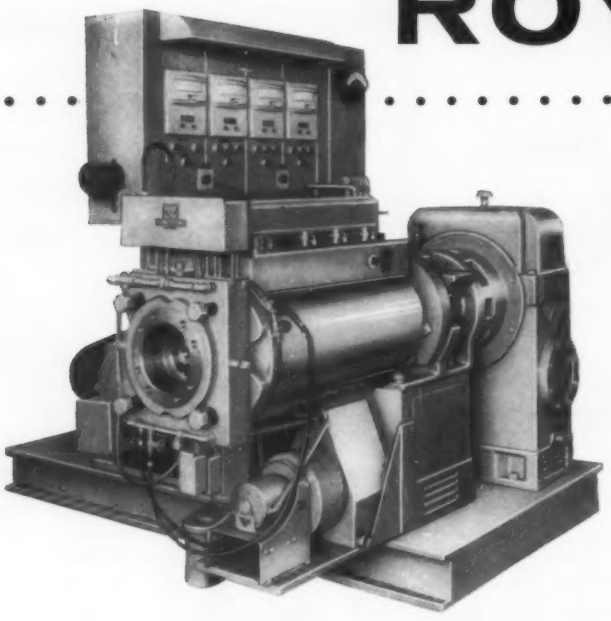
ROYLE

SPIROD® EXTRUDERS



These all electric extruders with radiant heat and high velocity evaporative cooling are designed to process either plastic or rubber compounds. The result of more than three quarters of a century of experience — Royle pioneered the extrusion process in 1880— in the design and construction of extruding machines time tested features have been built into Spirod to assure dependability.

Write for Bulletin #463

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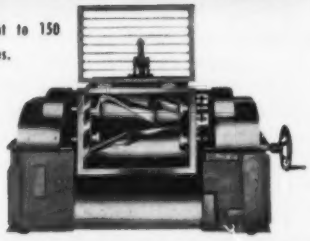
• 1 pint to 150 gal. sizes.



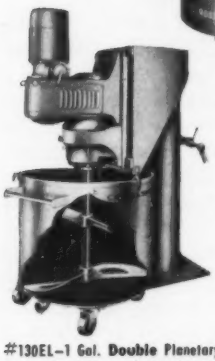
#41L–10 Gal. Double Arm Kneader with two speed brake motor. Jacketed trough and motor operated lift optional.

• 4½ x 10, 6 x 14, 9 x 24, 12 x 30, 14 x 32, 16 x 40" sizes.

#52TC–14" x 32" High Speed Three Roller Mill. Hydraulic adjustment and pressure recording gauges optional.

#30C–50 Gal. Heavy Duty Change Can Mixer. Adjustable outer scraper, cover with charging port, and gates on cans optional.

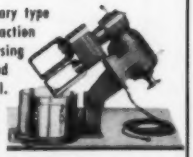
• 8, 16, 20, 50 and 60 gal. sizes.



#130H–250 Gal. Change Tank Mixer with hydraulic raising and lowering and variable speed motor. Various type stirrers and high speed impellers optional.

• 80, 150 and 250 gal. sizes.

#130EL–1 Gal. Double Planetary type Change Can Mixer with shearing action stirrers, and variable speed reversing type motor. Jacketed cans and portable trucks for cans optional.



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Write for complete information on these or other types of Ross equipment.

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Folding shower doors

(*From pp.* 144-145)

lower tracks have been positioned, it is simply a matter of engaging the rollers in the track of the aluminum header. Self-adjusting to fit any length of tub, the enclosure can quite easily be taken down in a matter of minutes if it is necessary to move it to another location.

In order to demonstrate sales features of this unit, American Shower Door Co. makes use of a miniature door in the form of a counter display requiring less than three feet of space. This display, incorporating actual sections of the polyethylene panels, enables prospective purchasers to feel the texture of the plastic material, test its resistance to breakage, and compare the available colors.

The Tub-master enclosure fits standard recessed tubs from 4½ to 5 ft. in length. An anodized aluminum trolley carries the entire weight of the extruded high-impact styrene panels, with the tub track acting only as a guide for the molded nylon slides at the bottom of the panels. Eight large nylon trolley wheels—four at the top of each section—provide silent, effortless operation.

Comes in pastel colors

The extruded plastic panels of the Tub-master enclosure are made in several pastel colors, in addition to white. The interlocking design of the individual panels and the aluminum hinge posts allows the doors to be collapsed but always maintains a watertight seal.

From their folded position, the sturdy plastic panels lift out of the tub track and hang from the upper track, exposing the entire tub for cleaning. Vinyl sealing gaskets used in installing the assembly have been reported to outlast rubber 3 to 1 and provide positive protection against splashing doors and walls.

Credits: Plastic panels for Tub-master doors extruded of Dow Styron 440 material. Injection molded nylon trolleys and slides for Tub-master doors, Engineered Nylon Prods., 1813 S. Olive Rd., South Bend, Ind.

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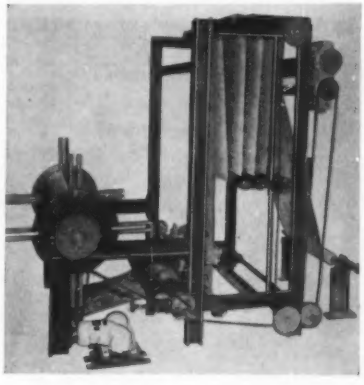

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Drill press

(*From pp.* 168-169)

so that drill and countersink do not meet.

As many as four drill press heads have been mounted in a cross arrangement for simultaneous operations. Two or three presses have also been mounted to permit simultaneous drilling of holes at an acute angle to one another.

For drilling large panels, single spindle heads have been mounted on double-hinged swinging arms to permit moving the drill to any point over a large area. Drill presses have also been mounted with the stand upside down on an overhead track for this same purpose.

Multi-spindle drill presses provide a number of drill heads mounted over the same table. A different size drill or different tool may be used in each head so that work passes from one position to the next without leaving the table until all operations have been performed.

Mounting the fixtures for frequently run small-lot operations on long plates that may be clamped to the table of a bank of drill presses is one smart idea that reduces set up time (Fig. 2, p. 168). Plates are marked with the part number and stored with the fixtures attached. When there is a production order for the particular part, the plate is quickly clamped to the table. Appropriate drills or tools are mounted in the drill head chucks to complete the setup.

The same operator may move the piece from one drill head to the next or there may be an operator at each tool. One ingenious production engineer mounted a rolling seat on an angle iron bench so that the operator is able to move from tool to tool on ball bearings.

For drilling long pieces, drill heads of a multiple-spindle machine may be actuated simultaneously either by a rod connecting their spindle operating handles or by simultaneous actuation of an automatic spindle feed attachment on each tool. This set-up is also used with a row of single spindle drill presses as it is easier

U.S.I.

Vol. II, No. 5

POLYETHYLENE PROCESSING TIPS

HOW CARBON BLACK QUALITY AFFECTS WEATHER RESISTANCE OF POLYETHYLENE

For cable jacketing and many other outdoor applications polyethylene offers substantial advantages over other materials. It is subject, however, to degradation from long exposure to sunlight unless the resin is properly protected.

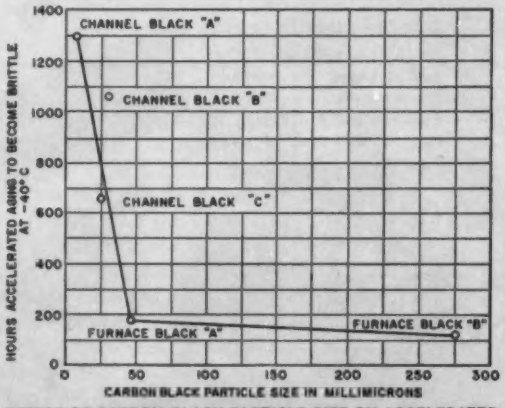
Actually, the aging of polyethylene is the result of a chemical reaction with atmospheric oxygen. Catalyzed by the ultraviolet rays in sunlight, this reaction proceeds more rapidly in outdoor use than is the case with indoor applications. The principal effects of aging are to increase brittleness at low temperature, and to decrease the resistance to stress cracking.

Carbon black dispersed throughout the polyethylene greatly retards this aging, or weathering. However, not all carbon blacks produce the same degree of weather resistance when dispersed in polyethylene. Moreover, the care with which the carbon black is dispersed in the polyethylene is vitally important.

The weather resistance of a polyethylene compound depends on: (1) type and particle size of carbon black; (2) percentage of carbon black in the compound; (3) the dispersion of the carbon black in the polyethylene.

Accelerated aging tests have been devised to approximate the action of years of outdoor exposure.

The graph below shows the great difference in number of hours required in these tests for a polyethylene to embrittle at −40°C when various carbon blacks having different particle sizes are used.



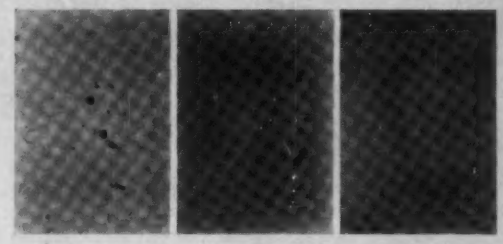
EFFECT OF CARBON BLACK PARTICLE SIZE ON ACCELERATED AGING OF POLYETHYLENE.

The two at right are "furnace blacks", and it will be noted that they are comparatively ineffective. The three at the left are "channel blacks", and obviously, they are many times more effective. This is due to their much smaller particle size — from about 10 to 25 millimicrons, against 50 to 275 millimicrons for furnace blacks.

Weather resistance also increases with the concentration of carbon-black — up to a point. Beyond this point the light screening effect is offset by a decline in other properties.

DEGREE OF DISPERSION IMPORTANT

Carbon black gives maximum protection only when it is thoroughly dispersed in the polyethylene. This presents a difficulty because the smaller the particles, the greater is their tendency to collect into clusters which, once formed, are hard to break up. Tests show that a good dispersion will withstand 15 to 20 times as much exposure to sunlight as a poor dispersion.



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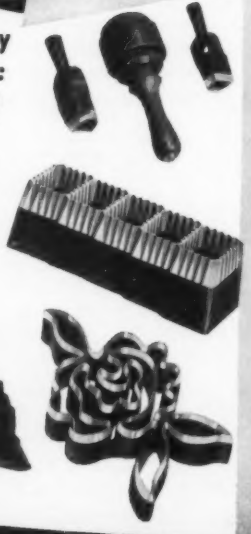

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to vary distance between holes with single-spindle than with multiple-spindle machines.

Milling, routing, shaping

Milling cutters mounted in a drill press head, plus an appropriate feed jig, simplify the milling of plastic surfaces. In milling a 0.010- by ½-in. step on one edge of a piece, one manufacturer put a 1-in. collar and 1½-in. milling cutter in a drill press chuck. Height of the spindle was set to mill the 0.010-in. depth as the piece was pushed past the cutter on a simple sliding jig. The collar held the step width to ½ inch.

Routing tools may be used freehand, with templets, or with movable jigs. A compound slide rest, designed for a lathe, makes a simple fixture (Fig. 3, p. 168) for accurate routing control.

Plastics may be readily shaped with standard or specially designed cutters mounted in drill presses. Shaping requires a guide fixture so that the piece may be pushed through uniformly.

Any grinding or polishing tool that can be held in a chuck or fitted on a Morse taper spindle can be used in a drill press (Figs. 4 and 5, p. 169). These include disk and drum sanders, abrasive disks, and regular and cup grinding wheels. When grinding wheels or abrasive cutting disks are used, the manufacturer's instructions concerning speed and guards should be strictly followed as centrifugal force of rotation can cause the wheels to break apart even under light pressure.

Spin welding

An interesting adaptation of the drill press is in the spin-welding technique recently developed at the Du Pont Polychemicals sales service laboratory. In one application, molded plugs for nylon aerosol bottles[1] are mounted in the drill press and forced down into the bottle while spinning (Fig. 6, p. 169). Frictional heat softens the contacting surfaces, which fuse into a single solid unit when press is stopped. Air cylinder, timer, and special fixtures (Fig. 7, p. 169) improve control of the process.—END

[1]See also "Glamor for aerosols." MODERN PLASTICS 34, 86 (Aug. 1957).

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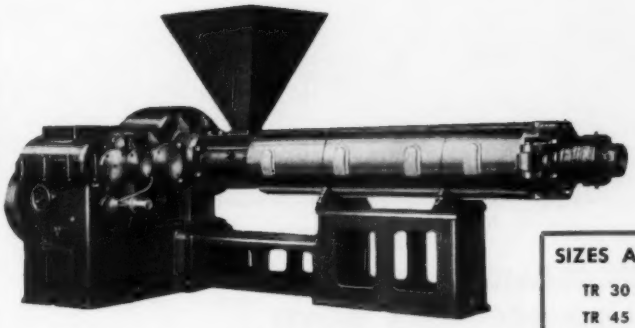

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INJECTION PRESS. 8-page booklet discusses features of 28 oz. injection press that handles 165 lb. an hour. Includes comprehensive specifications chart. National Automatic Tool Company, Inc. (I-726)

MIXERS FOR PLASTICS. Illustrated folder describes mixers for plastics materials, including spiral ribbon, double arm, and vertical models. Read Standard. (I-727)

LUMINESCENT PIGMENTS. 16-page booklet describes luminescent pigments, suitable for pigmenting plastics by spraying, coating, brushing, dusting. Includes illustrations of applications. Rhode Island Laboratories, Inc. (I-728)

COMPRESSION PRESSES. Folder describes company's 75-ton hydraulic press, and a 50-ton press suggested for laboratory use. Atlas Hydraulics, Inc. (I-729)

HYDRAULIC CYLINDER CATALOG. 8-page catalog contains diagrams and specifications for line of high pressure hydraulic cylinders with 1¾ to 12 in. bores that operate at over 2,000 p.s.i. Miller Fluid Power. (I-730)

CUSTOM MOLDER. 16-page illustrated booklet describes compression, injection, reinforced plastics molding, mold making, finishing, performed by this Illinois company. Molded Products Division of Admiral Corp. (I-731)

MOLDING PRESSES. Illustrated 12-page booklet contains specifications for line of 2 to 32 oz. injection presses, and 50, 175, 350 ton transfer presses. Also shows temperature control units. Improved Machinery, Inc. (I-732)

STABILIZERS FOR VINYLS. Booklet gives data on properties, performance characteristics and uses of line of stabilizers. Includes recommended formulations for calendered film and sheeting, extrusions. Argus Chemical Corp. (I-733)

VINYL COATINGS. Folder lists applications for line of vinyl resins, including polyvinyl acetate, polyvinyl acetate copolymers, polyvinyl butyral. Shawinigan Resins Corp. (I-734)

HEAT SEALERS. Illustrated folder describes ½ to 30 kw. electronic heat sealing equipment. Lists typical fabricated products sealed by this equipment. Sealomatic Electronics Corp. (I-735)

HIGH DENSITY POLYETHYLENE RESIN. Illustrated technical bulletin describes a high density polyethylene resin. Includes comparison of properties with conventional polyethylene. Spencer Chemical Co. (I-736)

VINYL PLASTISOL. 12-page booklet discusses production methods, recommended uses, and provides properties chart for line of "Chem-O-Sol" vinyl plastisols. Chemical Products Corp. (I-737)

TEMPERATURE CONTROLS. Illustrated catalog contains specifications for line of mounted temperature control equipment. United Electric Controls Co. (I-738)

HOSE FOR MATERIALS HANDLING. Illustrated folder describes wire-reinforced cotton base and nylon base fabric hose for conveying air, dust, fumes, and materials via pressure, suction, gravity. The Flexaust Co. (I-739)

POLYMERIZERS. Illustrated folder describes company's glassed-steel reactor units for the polymerization of synthetic resins. Includes specifications, diagrams, engineering data. The Pfaudler Co. (I-740)

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LAMINATED RODS AND TUBES. 12-page catalog describes laminated thermoset rods and tubes suitable for electrical, chemical, mechanical applications. Includes charts on tolerances, sizes, colors available. Synthane Corp. (I-743)

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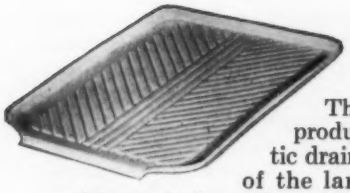

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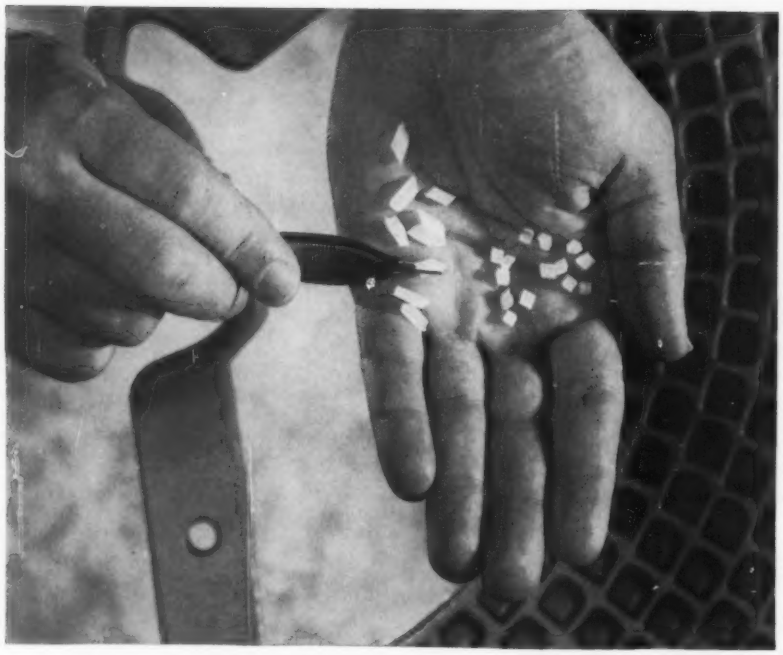

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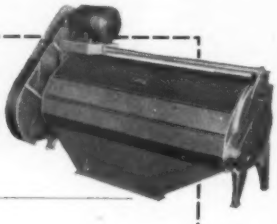

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Silane finishes

(*From pp.* 178-182)

ing the contained amino groups. The availability of a free amino group in A-1100 provides the chemical background for the introduction of this silane molecule into this resin system. The known reactivity of the silane ester portion of the molecule with glass should give this silane the necessary qualities to make it effective with melamine resins. Heat-cleaned HG-28 glass finished with A-1100 was treated with "Melmac"[2] 405 by a commercial glass impregnator and was then pressed into panels by a laminate fabricator. Electrical tests were performed by him on these panels. Table IV gives his data as compared to the usual values guaranteed by the trade. The exclusion of water and moisture from the laminates at the critical glass-resin interface is adequately shown by the test results, especially under conditions of moisture.

It was also expected that there should be a sizable improvement in the mechanical properties of melamine laminates where the A-1100 coupling agent was used. When samples were tested in flexure, rather remarkable strengths were obtained. With heat-cleaned glass cloth, dry and wet flexural strengths ran about 26,000 and 9,000 p.s.i., respectively. With the A-1100 treatment on the same glass, strengths always fell into the 80,000 to 100,000 p.s.i. range, and the wet strength retention averaged just about 100 percent. The A-1100 application had tripled to quadrupled the dry strength and increased the wet strength by an order of magnitude over heat-cleaned glass. The A-1100 treatment was also found to have a marked effect on carmellized (finish 111) HG-28 glass fabric, approximately doubling the dry flexual strength found with laminates that are made with melamine resin.

Epoxy laminates

The application of A-1100 as a size in the manufacture of glass yarn has been developed in co-

[2] A product of American Cyanamid Co.

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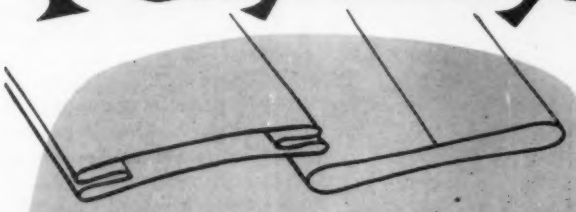

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operation with a major fibrous glass producer and the yarn is now being used on a commercial scale for the manufacture of certain types of glass-epoxy pipe. The use of A-1100 for epoxy laminates has been slowed by a side effect of the finish. Being an amine, and being attached all over the surface of high-surface area glass, the finished glass behaves as a highly dispersed hardener and causes premature gelation of the epoxy resins, resulting in unusually thick, air-filled laminates. This problem can be overcome by minor changes in handling technique and by diminishing the amount of hardener added to the resin.

Specificity of finish

The foregoing has served to indicate the specificity of a finish for a given resin system. The selection of the correct reactive groups in the silane applied to the glass ensures an improvement in mechanical and physical properties. Thus, the vinyl silanes react with the double bonds in polyesters and the amino group reacts into epoxies, melamines, and phenolics. To illustrate the specificity of these reactions the data obtained on heat-cleaned, vinyl silane (A-172) and amino silane (A-1100) treated 181 fabric with melamine resin are given in Table V, p. 182. The vinyl silane is of relatively little use with melamines, and it has been established that the amino silane is equally ineffective with polyester resins.

This experimental work shows that the type of bonding between fibrous glass and resin systems was improved considerably. The results are significant steps toward achieving, ultimately, a reasonable approximation of the tremendous inherent strength of fibrous glass in a resin-glass composition. Experimental work aimed at achieving this goal in the not too distant future is continuing at the present time.

Another clearly demonstrated point is the need for careful selection of the chemical species involved so as to achieve the optimum results in all cases. There are several silanes, and other materials, that have some utility as "across-the-board" finishes with many resin systems. But, in the final analysis, they do not do as well as the specific finish selected on the basis of reactivity, for example, vinyl groups for polyesters, amino groups for phenolics. Chemical groups for specific reactivity and further improved bonding with other commercially important resins are under study and evaluation now.

The extension of this work into the field of other resin fillers is clearly indicated. Asbestos and textile fibers could stand an improvement in the strength of their bonds to resin systems. The treatment of powdered resin fillers, such as asbestos, clay, mica, cellulose, carbon, etc., should closely follow this study of glass fibers and should yield considerable improvements and changes in various properties, including strength, wetting, and thermal resistance.—END

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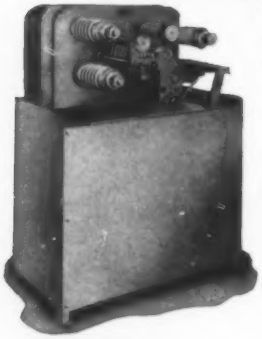

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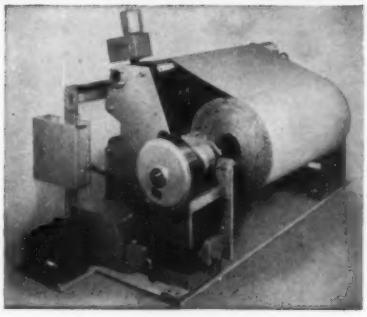

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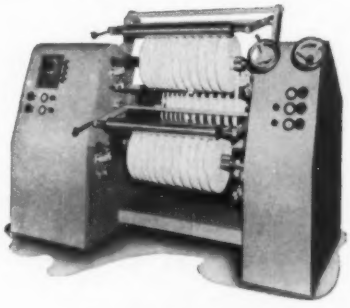

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Heat distortion

(*From pp.* 184-190)

temperatures approaching the heat distortion point, other factors become more and more important, and the values of the various properties may change radically and at rates that could not be predicted from relative heat distortion values.

The heat distortion point cannot be used as a criterion for predicting other properties such as bond strengths and dielectric strengths. For example, in adhesive applications, such factors as wetting and chemical forces between substrate and adherend determine the absolute bond strengths. The heat distortion point indicates the temperature near which the bond strength will be expected to begin to fall off. Catalyst CL and triethanolamine with Epon 828 give comparable bond strengths at 100° C. on aluminum, yet at 130° C. the bond strength of the triethanolamine-based adhesive has fallen off rapidly while that of the CL system is the same. On the other hand, *p,p'*-methylene dianiline, which gives resins of high heat distortion points, has been reported to give adhesives with very poor bond strengths (3).

In applications involving electrical performance, the heat distortion points of epoxy systems often define the temperatures near which the electrical properties will start to change rapidly, yet the difference in the elevated temperature electrical properties of epoxy resins cured with two different catalyst systems may be independent of the heat distortion point. For example, piperidine- and phthalic anhydride-cured systems have comparable heat distortion points, yet quite different electrical properties at 125° C. The Shell catalyst CL-system, which has a much higher heat distortion point than the others, has a lower power factor at this temperature.

In applications dependent on physical properties at elevated temperatures the heat distortion point is very important. However, at temperatures near the heat distortion point, it gives no information on such properties at creep

SUMP TYPE (cutaway)

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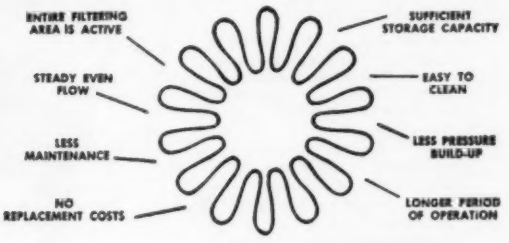

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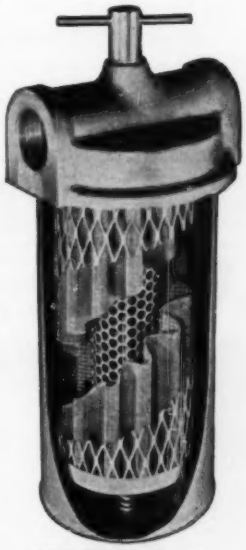

LINE TYPE (cutaway)

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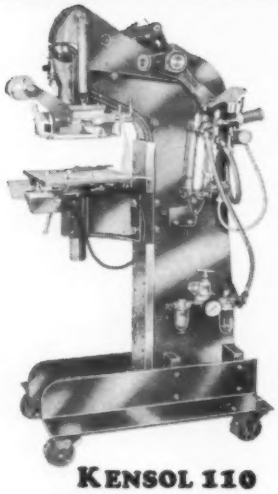

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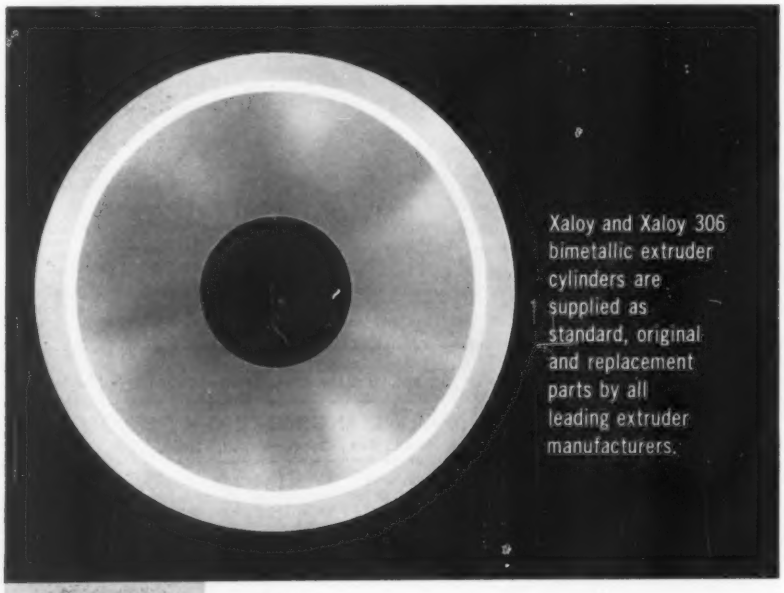
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and plastic flow, and at temperatures above that point gives no indication of the state of the resin.

The heat distortion point will be of importance in the matter of predicting chemical resistance only where there is no chemical reaction between solvent and resin. Where the possibility of chemical attack exists, the method of cross-linking the resin, which is dependent on the catalyst used, and the chemical nature of the catalyst and resins themselves may be the important factors.

This discussion has been limited to consideration of various catalyst systems as a function of heat distortion point alone. Pot life, curing schedules, exotherms, viscosity, toxicity, and cost have not been considered.

In conclusion, the heat distortion points of epoxide resins cannot be correlated with all other resin properties at elevated temperatures. Since this point can be considered as only one point on a temperature-strain plot at constant stress, many more data are required before any material can be used safely at a temperature near the heat distortion point. It must be determined that the operating stress of the application is below that of testing since the heat distortion point can decrease markedly with increasing load. In general, it serves to indicate the approximate temperature below which most properties can be expected to be fairly stable.

The assistance of G. W. Roberts and D. I. MacDonald in preparing and testing many of the samples is acknowledged.

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2. Feild, R. B. and Robinson, C. F., Preprint of papers presented at the Dallas Meeting, American Chemical Society Division of Paint, Plastics and Printing Ink Chemistry, Apr. 1956.
3. Talk given by J. Formo entitled "Application of Epoxy Resins" at the 11th Annual National Technical Conference of the S.P.E., Jan. 1955.
4. McGuiness, E. W., Materials and Methods *43*, 122 (Mar. 1956).

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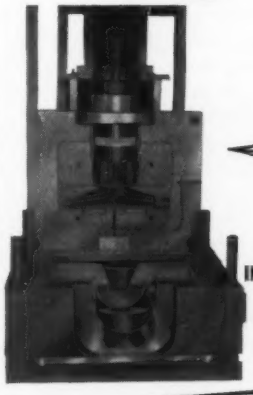

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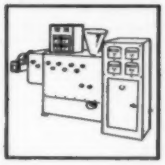

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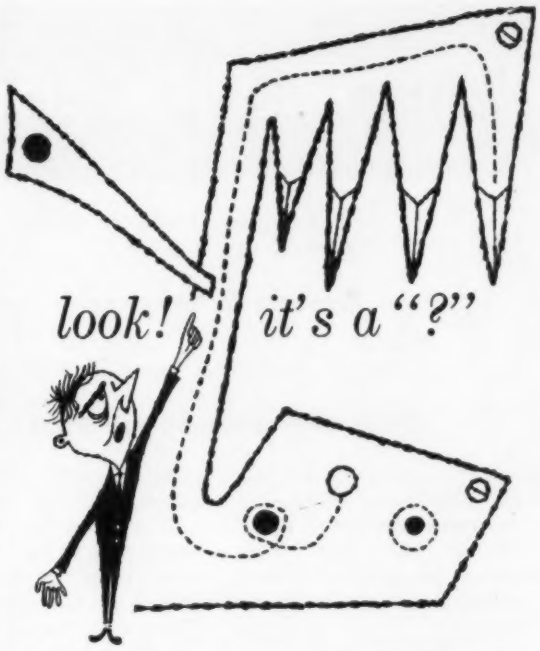

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OUR ONLY FUNCTION IS TO SAVE YOU MONEY

The Plastiscope

News and interpretations of the news
By R. L. Van Boskirk

Section 2 *(Section 1 starts on page 37)*

More polyethylene for what?

Last month's announcement that Hercules was ready to produce low-pressure-processed linear polyethylene has once more opened up the question of how and where the new high-density polyethylenes will fit into the over-all plastics pattern.

Up to now there has not been much of the new material on the market—at least if there has been it hasn't been labeled as such. It could be that sizable amounts are being blended with low-density polyethylene to obtain certain properties in a finished product, information on which is being held confidential. There were a few molded items of high-density material at the Atlantic City Housewares Show that are actually in production, a few samples not then in commercial production at the Packaging Show last spring, and there is a sprinkling of toys and laboratory vessels in existence. Some interesting samples of film have been shown, but apparently it is not yet in commercial production.

One reason for this paucity of finished items is price—low-density polyethylene is 35¢/lb.—high-density, linear type is 47 cents. Another reason is that it seems necessary to build new molds in order to successfully use the new material. The price situation will probably change before long even though producers claim the disparity is less than it seems since smaller amounts of the new polyethylene can be used for a given job because of its greater stiffness. The mold situation will probably require many months to adjust. (See "Injection molding rigid polyethylene," p. 149, this issue.)

In view of this situation, it is interesting to note some suggestions made by Hercules as to where the new material is most likely to be found in the future. These are based on performances of 1 million lb. of material imported from Hoechst of Germany with whom Hercules has an agreement for exchange of know-how. Because of this exchange, Hercules expects to be able to produce a commercial grade that exactly matches the experimental grade. Here are some of the Hercules suggestions:

Paper and wire coatings. Since its abrasion resistance is so great, the new Hi-fax (Hercules polyethylene) can be used as a coating on paper with 5 to 30 times greater durability than conventional polyethylene. This application is highly significant since it is beginning to look as though polyethylene-coated paper may soon become one of the fastest growing sectors in the industry. Producers of high-density material claim their product can be used in even thinner sections than low-density polyethylene. That same abrasion resistance is also of paramount importance for wire coating because the new material may not require jacketing.

Housewares. In housewares, Hi-fax is expected to become not only a partial replacement for other plastics but also to be used for many applications where other plastics couldn't qualify. Greater rigidity, heat resistance that permits sterilization, extra fine surface, and good color range are the chief properties that can help this move.

Chemical ware. In chemical ware, Hi-fax is already established for such items as graduates, beakers, funnels, test tubes, and vials. Heat resistance, impact strength, chemical resistance, and translucency make it particularly applicable in this field, where it is claimed to be more satisfactory than glass in many instances.

Vacuum forming sheet. Hercules insists that Hi-fax sheet is adaptable to vacuum forming in economical cycles despite much comment to the contrary and furthermore states that it compares favorably in price on a square-inch basis with such rigid materials as cellulose esters, rigid vinyls, and high-impact styrenes.

Another suggested use for Hi-fax is in bottles—particularly nursing bottles where wall thickness can be reduced from 40 to 25 mils, resulting in 25% savings in material. Blow-molding cycles are also claimed to be faster with the new material.

Only a few. These are only a few of the products expected to be produced from Hi-fax. Hercules spokesmen point out that it is not their belief that the new polyolefins, such as polyethylene and polypropylene, will displace any major share of any existing plastic. Rather, they expect expansion in new plastics markets beyond anything yet believed possible.

Along this line, the president of Hercules mentioned that his own company's profit pattern had changed considerably since World War II, with petrochemicals now forming 27% of the company's business compared to less than 5% at that time. Other percentages in those days ran 50% for cellulosics, 30% for rosin and terpene, and 20% for explosives. Among the company's new products are phenol by the air-oxidation process, methanol, formaldehyde, and pentaerythritol.

Inventor sees his handiwork. Prof. Dr. Karl Ziegler of the Max Planck Institute in Germany was among those present when Hercules opened its new plant which employs the Ziegler method for production of low-pressure-processed polyethylene. There are

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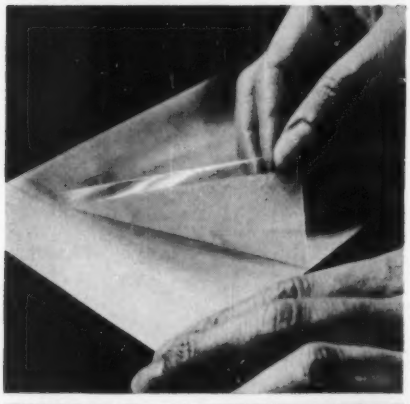
RIGID

Acrylics; cellulosics; polystyrene and co-polymers; vinyl; nylon; vulcanized fibre; hard rubber; reinforced laminates of silicone, urea, melamine, polyester, phenolic, epoxy; flourinated resins; etc., and all metals.



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Cellophane; cellulose acetate; cellulose acetate butyrate; cellulose nitrate; Mylar; Pliofilm; polyethylene; polyvinyl alcohol; polystyrene; Saran; vinyl; etc., and all foils.

EXPANDED FOAMS

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seven licensees of the Ziegler process in the U. S. Of these, Koppers will soon be in production in a 30-million-lb. commercial plant in New Jersey, following two years of semi-works plant production. Bakelite announced some time ago that their Ziegler plant would start up this fall. The other four have not reported on their progress.

Prof. Dr. Ziegler said the beginning of his discovery started 25 years ago when he began research in the field of organometallic compounds. The climax came by chance in 1953 after failure to polymerize ethylene with aluminum triethyl, when it

Prof. Ziegler (left) chats with E. Hinner, mgr. of Hercules Cellulose Products Dept.

was suddenly discovered that aluminum trialkyd could be activated as a catalyst for polymerization of ethylene at normal pressure. Activation of aluminum alkyds was done by adding compounds of titanium, zirconium, chromium, and the like.

Prof. Dr. Ziegler was born on Nov. 26, 1898 in Helsa, near Kassel, Germany. In 1920 he received his doctor's degree at the University of Marburg/Lahn. For 10 years he was a professor at the University of Heidelberg.

In 1935 he received the Liebig Medal for outstanding research work in the field of radicals with trivalent carbons, and for his thoroughly worked-out synthesis of multi-linked ring systems. In 1936 he became professor and director of the Chemical Institute at the University of Halle. During the same year he lectured as guest professor at the University of Chicago.

In 1943 he became a chairman of the Max Planck Institut für Kohlenforschung in Mulheim/Ruhr. After the war he helped re-establish the German Chemical Society, of which he was president for five years. In 1954 he became president of the German Society for Petroleum and Coal Chemistry. In 1955 he became chairman of the Chemical-Physical Section of the Scientific Council of the Max Planck Society, and has received various decorations and honors from chemical and scientific societies.

Prof. Dr. Zeigler's work is also his hobby. However, he travels extensively and is an active mountain climber. In the summer of 1952 he climbed the Matterhorn. In the spring of 1955 he spent several months in Egypt and the Levant. In 1956 he traveled to Japan, and was received there by the Emperor.

Custom-formulated resins

A service for the confidential formulation of made-to-order specialty resins and polymers in bulk, suspension, solution, or emulsion is being offered by the Monomer-Polymer Laboratories of Borden Co.'s Chemical Div., Philadelphia, Pa.

According to the company, laboratory and pilot plant facilities are available to handle all customer production requirements, including composition, viscosity, solids content, and other individual specifications. Block and graft polymers and polyelectrolytes such as methacrylic acid/vinyl pyridine copolymers are part of the service.

Mass-produced laminates

An experimental technique developed by Minnesota Mining & Mfg. Co., St. Paul, Minn., permits laminating of thin-gage heat-sealable polyester film to cards, documents, or paper to make them tamperproof.

The process involves two rolls of film, arranged so that the films do not meet until after a short length of web travel. The material to be laminated is placed on top of the bottom film and is carried along on the web until it is covered by film unwinding from the second stock roll. The three-ply assembly then travels through a sandwich-type heater, through laminating rolls, and then through a paper cutter where the finished laminate is cut off.

BFG to teach how

In an effort to familiarize plant engineers across the nation with techniques of fabricating and installing Koroseal rigid PVC pipe and sheeting, the Plastics Div. of B. F. Goodrich Industrial Products Co., Marietta, Ohio, has organized a mobile "school."

The demonstration unit will be sent on a 15-month nationwide tour and is expected to be used in over 1000 class demonstrations.

Mylar-styrene laminates

Laminations of metallized Mylar to high-impact and oriented polystyrene sheet have been announced by Flexcon Co., 41 Maple St., Spencer, Mass. The company states that the finished laminates can be vacuum and drape formed without affecting the bond strength between the materials. It is also available in patterns and embossings.

Applications for the laminates are in the refrigeration, radio cabinet, aircraft, automotive, and advertising fields.

Flexcon also has facilities for printing, coating, laminating, and embossing 0.00025- to 0.001-in. clear and metallized Mylar to vinyl, paper, and woven and nonwoven fabrics.

PVC wire insulation

A new polyvinyl chloride, compound—Opalon 71344—especially formulated for use as primary insulation on aircraft wire, has been introduced by Monsanto Chemical Co.'s Plastics Div., Springfield, Mass. According to the company, laboratory tests indicate that wire insulated with the product is suitable for use in temperatures rang-

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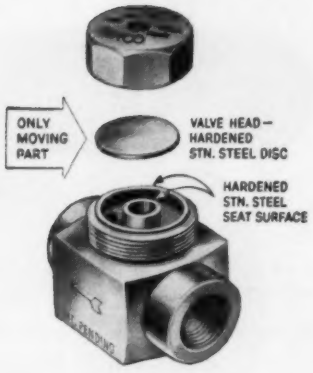

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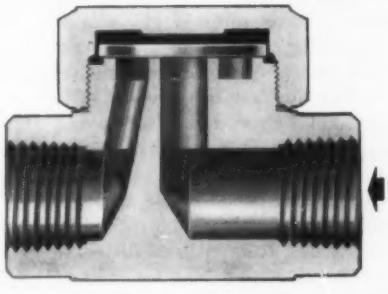

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ing from —55 to 105° C. Extrusion characteristics are said to be good.

Opalon 71344 is available in natural, black, white, and colors.

Versatile copolymer emulsion

Vinyl acetate-vinyl stearate emulsion, Flexbond 100, produced by Colton Chemical Co., a Div. of Air Reduction Co., Inc., Cleveland, Ohio, is recommended for the formulation of textile coatings, adhesives, saturants, paper coatings, binders, paint finishes, and protective coatings.

Film properties of Flexbond 100 are claimed to include high water resistance, fine particle size, clarity, transparency, permanent flexibility, good adhesion, nontoxicity, and greaseproofness.

More epoxies

Two additional formulations—Sonite SC-1 and Sonite LM-1—have been added to its line of epoxy resin compounds by Smooth-On Mfg. Co., Jersey City, N. J.

Sonite SC-1, a light yellow material with sufficient thixotropy for application as a heavy brush coat without sagging on vertical surfaces, is said to offer many advantages when used as the gelcoat for hand laminations, as a surface coating for tanks and barrels, or as a bonding agent with good adhesion and chemical resistance and stability. When used in conjunction with Sonite LM-1 laminating resin and glass cloth, strong, lightweight plastic tools with good dimensional stability are said to be possible.

Sonite LM-1, an epoxy resin compound recently perfected by Smooth-On, has been specifically formulated for use in hand laminating systems. The company claims that the formulation has maximum wetting characteristics with sufficient thixotropy for application to vertical surfaces and forms a cured resin that has high strength and dimensional stability. In addition to its use in production of laminated plastic tools, the material can also be used as a tank surface coating or as a bonding agent.

New Western States Editor

In a move to localize and intensify its coverage of rapidly expanding plastics activities in the 11 western states, MODERN PLASTICS announces the appointment of Edmund L. Van Deusen, a former associate editor of *Fortune* magazine, as its Western States Editor.

Van Deusen

Mr. Van Deusen, who lives with his wife and three children in Laguna Beach, Calif., will operate out of the Los Angeles office of MODERN PLASTICS at 6535 Wilshire Blvd., Los Angeles 48.

A talented writer who has contributed to *Collier's* and other magazines, Mr. Van Deusen is well qualified also by his business and publishing experience. A chemical engineer, graduate of Pennsylvania State University, he has bought chemicals for Du Pont, sold chemicals for Davison, and written about buying and selling for *Chemical Week* magazine. At *Fortune* he authored a number of major articles on plastics materials and the plastics industry.

Distributors for plastics

A highly significant move that may be a forerunner of considerably expanded activity in the plastics distribution field was the recent merger of Dayton Rubber Co. and Cadillac Plastic. The merger itself was important because it will enable Cadillac to do a more thorough job of distributing plastics sheet in large as well as small quantities; of even more importance was the channeling of more capital into a sector of the plastics industry with great growth potential—distribution.

There are several distributors of plastics sheet scattered here and there about the country, but a much more thorough coverage is needed if the industry expects to take advantage of the markets that can be developed by hundreds of small-volume users and retailers of plastics sheet.

There are now scores of small stores or shops in various communities which specialize in selling small lots of semi-finished plastics to do-it-yourselfers and in producing signs or other fabricated items. It is essential that they have sources of supply from which they can obtain methacrylate, styrene, acetate, vinyl, and other materials in the form of rods, sheets, film, foam, or semi-finished products in small quantities.

A distributor would be in better position to handle these varied needs than raw material suppliers or extruders and at the same time keep his eye open for big order jobs. Perhaps these distributors could perform at least part of the same functions that retail lumber yards do for the forest products industry.

Nearly every sector of the plastics industry has been and still is troubled by distribution problems, and it seems logical to believe that a distributor system built up by a management that understands plastics' innumerable complexities and with enough capital to operate on a big scale could be a great boon to the industry.

Cadillac Plastic began operations shortly after World War II by selling surplus plastics sheets and has opened six new branches within the last three years. The company now claims to be the largest warehouse distributor of thermoplastic sheets, rods, and tubes, with 25,000 active accounts distributed through more than 50 industries. It is national distributor for more than 25 plastics lines. Sales in 1957 are expected to exceed $8 million. The Cadco Div. of Cadillac has concentrated on development and manufacture of product lines which serve the needs of limited markets.

Dayton Rubber is one of the larger rubber companies outside of the Big-4 and is a principal producer of mechanical rubber

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The Plastics Industry is "buzzing" about the new Natco 400 . . . the 28 ounce injection machine that has everything . . . speed . . . controls . . . and the ability to run continuously without costly down time because its hydraulic system is completely shockless!

Radio cabinets are always tough and the 21½ ounce job shown here is no exception . . . off center sprue . . . sharp square corners . . . heavy ribs and bosses . . . multiple openings! Yes, 70 cabinets per hour with less than 1% rejects . . . that's the record of the new Natco 400. And that's not all . . . the weight of the cabinets varied less than one gram!

Investigate what a new Natco will do for you. Sizes range from 16 to 85 ounces. Write today for complete information.

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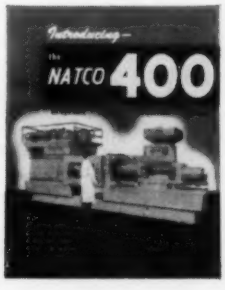

National Automatic Tool Co., Inc. Richmond, Indiana

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goods—it pioneered the rubber V-belt for autos and is a leading manufacturer of foam rubber and a pioneer developer of polyurethane foam. The main plant is in Dayton, Ohio, with six other large-scale operations with subsidiary companies that include American Latex Products Corp., Metalastic Corp., and Sponge Rubber Corp. Sales for the year ending 1956 were over $75 million. Dayton has now followed the lead of many other rubber companies in entering the plastics industry but has chosen a different and individualistic doorway that should make Dayton a potent influence in the industry.

Antiseptic coating

Sterilon, an antiseptic coating for objects which are handled by the public but seldom washed (telephone handsets, toilet seats, banisters, etc.), is being offered by White Chemical Co., 1505 Capitol Ave., Bridgeport, Conn. The coating consists of a hydrophilic methanol - formaldehyde - nylon polymer containing 5 to 10% by weight of an active antiseptic such as iodine.

The coating can be applied by dip, spray, or brush. Metal objects should be precoated with shellac. Plastics products usually require an acid or caustic dip as pretreatment. The period for which the coating remains effective depends on usage and thickness of the coating. Typically, a 3-mil coating on a telephone mouthpiece has an effectiveness of 1 to 2 years.

Dynel felt overlays

Mechanically interlocked felt for use as overlay material to improve performance of reinforced plastic laminate structures has been developed by American Felt Co., Glenville, Conn.

One of several new synthetic fiber materials introduced by the company under the tradename Feutron, the felt is made of 100% Dynel acrylic fiber produced by Union Carbide Corp. It is recommended to upgrade low-pressure laminated glass mat structures such as boats, swimming pools, automobiles, ducts, hoods, pickling tank covers, linings, etc.

Use of the felt overlay is said to eliminate the need for a gel coat and to provide a smooth, uniform surface requiring only half of the sanding necessary with non-surfaced laminates.

Other properties of Feutron felts cited by the company are uniform weight and thickness; three-dimensional strength properties; good wettability; high strength and elongation; and good dielectrical properties, even under wet or high humidity conditions.

The felts are being produced in widths up to 80 in. and lengths of 60 yd. or multiples thereof, in selected weights as low as 2 oz./sq. yard.

Epoxy-glass laminate

A continuous-filament, woven glass fabric base laminate, impregnated with a heat-resisting epoxy resin and designated Grade G-11, has been announced by Synthane Corp., Oaks, Pa. The laminate, which conforms to MIL-P-18177 (Ships), Type GEE, retains at least 50% of its initial flexural strength after baking for 1 hr. at 150° C. It is anticipated that Grade G-11 will be eventually covered by a military specification of its own.

The new material is available in sheets or as parts fabricated to customers' specifications, as well as in copper-clad form.

Suggested applications include guided missile parts, printed circuit boards where high bonding strength gives improved performance, and for all applications requiring resistance to fungi attack where "tropicalization" of material would otherwise be necessary.

New B-O-N red

Polaris Red CP-1285, a non-bleeding, bright, bluish B-O-N red whose light resistance is said to be superior to other non-bleeding azo reds, has been developed by the Pigment, Color and Chemical Div., The Sherwin-Williams Co., Chicago, Ill. It is claimed to be particularly useful in vinyls, polyethylene, synthetic fibers, and rubber. CP-1285 is also reported to be easy to grind and to have a tinting strength similar to that of Lithol Rubines.

Reinforced epoxy molder

Entry into the field of custom molded reinforced epoxies has been announced by The Combs Engineering & Mfg. Co., Wallingford, Conn. The company will produce moldings on a production basis, using glass reinforced epoxy premixes and matched-metal molds. Resins are supplied by Ciba Co., Inc., and Shell Chemical Corp. and premixes are compounded by Combs for each job.

A specially formulated release agent is said to produce moldings with a high glossy finish and good reproducibility. Tolerances of 0.002 in. are possible for production parts, according to the company. Combs is also equipped to produce cast epoxy parts.

Consulting firm

Formation of Consulting Associates, 1096 E. 64th St., Cleveland, Ohio, has been announced. The firm will provide services in all branches of engineering and chemistry, including high polymer and coatings technology, plant design, testing, economic and technical surveys, contract research, chemical processes, mechanical controls design, instrumentation, and formulation.

E. I. Arsan is technical director.

Thermoformable sheet is metallized

Metallized polystyrene sheet for vacuum forming has been jointly announced by Coating Products, Englewood, N. J., and Gilman Brothers Co., Gilman, Conn. The base sheet is produced by Gilman from Dow's 475 and 480 formulations and metallized by Coating Products.

The material, designated Mirro-Brite Gilco polystyrene, is available in thicknesses from 20 to 125 mils in sheets or rolls up to 40 in. wide. It is offered with any color

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background using a metallized finish on one side and a contrasting color on the other.

Prototype service

Sample molded prototype parts for mechanical or chemical testing or for market evaluation are now available from Baldwin Aircraft Instrument Co., 231 Front St., Brooklyn, N.Y. The firm produces such parts in low-cost temporary tools in quantities of from 500 to 2000 pieces, and claims that they cannot be distinguished from pieces molded on the most costly production type tools.

Custom molder

Darrill Products Co., Crandall Court, Attleboro, Mass., is a new custom molding company specializing in nylons, acrylics, and unusual applications of other plastics.

Additional services include: handmade samples; engineering; prototype tooling; production molds; assembly of molded parts; and lacquer spraying.

Speeds service

Plastics injection molders in the midwest can now get overnight delivery of plastic colorants from Plastic Molders Supply Co., Inc., by calling Chicago ENterprise 4615. This connects the molder direct with the firm's Sandusky, Ohio, plant at the price of a local telephone call.

Plastic Molders' home plant is located in Fanwood, N.J., however, engineering service and production facilities are available from the company's Sandusky plant as well.

Using a magazine to sell

Vinyl upholstery and wall covering in full color photos will be displayed to 30,000 persons every month in a new 12-page magazine to be published by the Marietta Div. of B. F. Goodrich Co. It will be called "Koroseal Coverage" and will show how vinyl-coated fabrics for walls and furniture can be used for decorative effects in an unlimited variety of applications. The cover of the first copy is a color photo of a children's playroom in a Philadelphia hospital where Koroseal is widely used.

Even though vinyl coverings are no longer a novelty in the furnishings field, they have still barely scratched the surface of the markets available in furniture upholstery and wall covering applications. A magazine such as Goodrich is offering could go a long way toward spreading the gospel among dealers and designers by showing them how the colorful effects of plastics can be fitted into far more homes and institutions than they have reached to date.

Plastic-aluminum coating

Ready mixed aluminum paint, formulated from synthetic thermoplastic resins and 325 mesh aluminum pigment, has been announced by Alumatone Corp., Los Angeles, Calif. Designated Alumatone 100, the finish is claimed to produce a tough, smudge-resistant coating with good adhesion to plastics, metals, glass, rubber, and wood.

Designed for assembly line operation, the coating is said to air-dry in 3 minutes. Coverage is approximately 650 ft. per gallon.

Million pound delivery

One million lb. of isophthalic acid, which arrived in New York from California by ship, marks the beginning of regular shipments to warehouses which can provide fast delivery to users of isophthalic in the east.

Isophthalic is produced by Oronite Chemical Co. at Richmond, Calif., and is suggested by the company as a replacement for phthalic anhydride in some cases. When polymerized with styrene, it helps to produce a resin with higher heat distortion, greater flexural and impact strengths, and lower flexural moduli. Processors can use larger amounts of styrene with isophthalic and thus save on cost, according to Oronite.

Clear polyamide resins derived from isophthalic show excellent toughness and impact strength, and possess softening points within the range required for industrial molding resins. High molecular weight polymers can be formed from isophthalic and several different glycols, opening up a whole new field of polyesters at attractive cost. With the Oronite plant turning out 50 million lb. of IPA per year, manufacturers will now have a source of supply of this important new ingredient for plastics products.

Polymer manufacturer

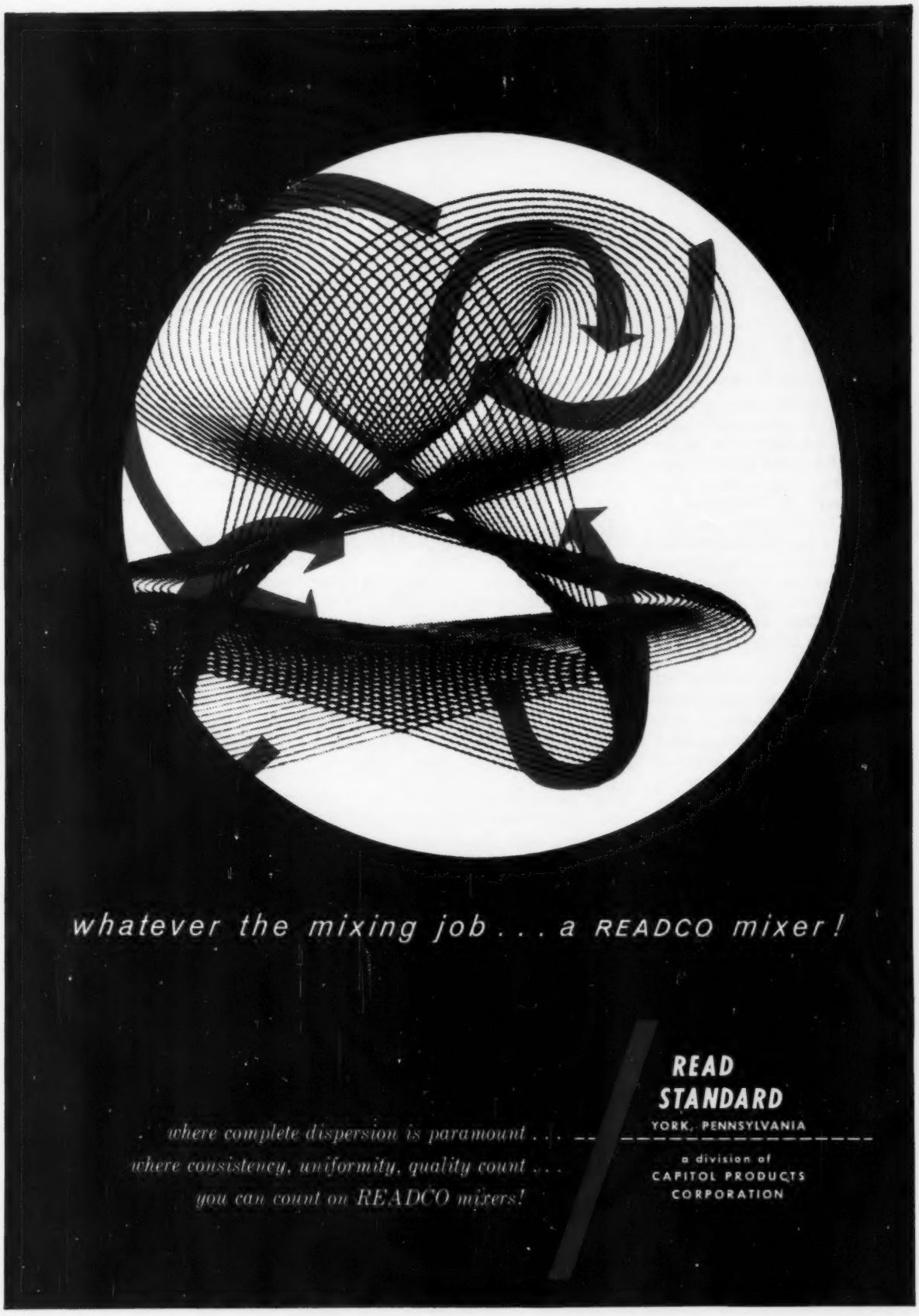
Formation of Carwin Polymer Products, Inc., as a wholly-owned subsidiary of The Carwin Co., North Haven, Conn., has been announced. The firm will develop, manufacture, and market industrial materials and end products based on polymers developed by the parent company. These polymers range from plastics to elastomers in both cellular and noncellular forms. They are under development as insulating, acoustical, shock absorbing, frictional, sealing, and reinforcing materials.

As in the parent company, C. E. VanWinckel and Richard Kithil serve as president and vice president, respectively. Ralph Perkins, Jr. is sales manager and David E. Cordier will be technical director.

Building material

Plastics for use in building will be a feature of the Building Research Institute's meeting in St. Louis, Mo., to be held September 17 to 18 at a conference open to the public. Among the subjects to be discussed are: phenolic and thermoplastic foam as thermal insulation; vinyl film as a vapor barrier; plastics flashing material; roof structures constructed of plastics; plastics and elastomer modified asphalts; and thermosetting and thermoplastic skylights.

The second day of the meeting will be devoted to a trip through the new Monsanto laboratory and talks concerning that building,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which is constructed of and furnished with plastics wherever it is possible to use them. (See MODERN PLASTICS, *34*, 124, June 1957.)

Fee for the session is $20. Apply to Harold Horowitz, technical secretary, Building Research Institute, 2101 Constitution Ave., Washington 25, D. C.

Improved laminate offered

A new melamine-surfaced decorative laminate, designated Beau-Myte and claimed to be denser and smoother than former laminates of this type, is now being manufactured and marketed by BoMyte Co., Silverdale, Pa. The improved properties are reportedly the result of a new but undisclosed laminating process. The company states that the product exceeds NEMA standards for high-pressure thermosetting decorative laminates.

Beau-Myte is available in all colors and patterns now offered to domestic laminate users. BoMyte supplies the laminated sheet for direct application to furniture surfaces in furniture plants or as a completely assembled unit permanently laminated to a particle board or plywood core.

Imitation gold

Swift Golden-Hue Metal #1 imitation gold for hot die stamping names and trademarks on plastics, lacquered wood, leather, coated cloth, or paper is being offered by M. Swift & Sons, Inc., 10 Love Lane, Hartford, Conn. Manufactured on a Mylar carrier, it is claimed to produce a brilliant plate-like impression which gives the appearance of genuine gold.

Second in Fortiflex series

Introduction of the second resin in its Fortiflex series has been announced by Celanese Corp. of America. The new polyolefin, designated Fortiflex A500, is in commercial production at the company's Houston, Texas, plant. Warehouse stocks of Fortiflex A500 are now on hand for shipment from Newark, N. J.; Chicago, Ill.; Los Angeles, Calif.; and Houston.

Fortiflex A500 is said to have unusually good flow characteristics and, therefore, is of advantage in molding larger parts without using excessive molding temperatures.

Plax in Belgian venture

Formation of a Belgian firm, Sidaplax, S.A., to manufacture and sell plastic bottles and other hollow articles and Polyflex biaxially oriented plastic film and sheet in the Benelux countries, has been announced by Plax Corp., Hartford, Conn., and Societe Industrielle de la Cellulose, a Belgian plastics manufacturer.

The new company will have its headquarters in Brussels and manufacturing facilities in Ghent. It is reportedly the first company outside the United States to produce Polyflex

More firms Sanitize

Over 600 companies have now been licensed to make their products bacteriostatic through the use of an additive produced by Sanitized Sales Co. of America, 181 Madison Ave., New York, N. Y. Latest additions from the plastics field are Athol Mfg. Co., Athol, Mass., producer of plastic coatings for the shoe industry, and Yaleco, Inc., New Haven, Conn., manufacturer of plastic and rubber children's wear.

Specialty laminates

Formation of Liberty Laminates, 47-40 Metropolitan Ave., Brooklyn, N. Y., has been announced. The company will engage in the development and production of specialty laminates involving fine and coarse papers, foils, glassine, cellophane, Mylar, fabrics, leatherettes, and fire retardant, barrier, and vaporproof materials, in widths up to 78 inches.

Sidney A. Grossman is president and Lawrence Grossman executive vice president. Jack MacVittle, formerly sales representative of St. Regis Paper Co.'s Cheslam Mfg. Div., is sales executive and will cover the Eastern Seaboard.

Large-diameter Kel-F tubing

Transparent Kel-F tubing in wall thicknesses of 0.06 to 0.08 in., diameters from 2 to 6 in., and lengths up to 12 in. is now available from Combs Engineering & Mfg. Co., 428 S. Cherry St., Wallingford, Conn. Applications include fuel gages, pipe sections, and linings, and as stock for machined O-rings and seals of large diameter.

The tubing can be bent and convoluted to provide flexible couplings and joints, and with attached metal flanges finds application in bellows and expansion joints.

Adhesives for packaging

Thermoplastic adhesives for sealing cartons on a variety of packaging machines have been developed by Pyroxylin Products, Inc., Chicago, Ill. The resultant seals are said to be unusually strong, siftproof, and waterproof.

According to the company, the adhesives, called Proxmelts, are used on packaging machines produced by Battle Creek Packaging Machines, Inc., Package Machinery Co., Oliver Machinery Co., Stokes & Smith Co., Binns Machine Co., Clybourn Machine Corp., R. A. Jones Co., Food Machinery Co., and others.

Phenolic tubing for press-fitted assemblies

Small diameter, paper-base phenolic tubing for high strength, press-fitted mechanical and electrical assemblies is being offered by National Vulcanized Fibre Co., Wilmington, Del. Designated Phenolite Grade XX-3113, the rolled tubing is recommended by the company for use where metal tubes or studs are to be inserted into tubular plastic insulators, such as in brush holder assemblies, insulated bushings, and other applications calling for pressure-fitted assembly. It meets NEMA specifications for grade XX rolled tubing.

Phenolite Grade XX-3113 is

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available in I.D. sizes ranging from 0.093 in. minimum to 0.379 maximum; in wall thicknesses from 0.010 to 0.088 in., depending upon piping size; and in lengths up to 25 inches.

The company reports the following values: typical radial compression—179 lb. for 0.104-in. I.D. by 0.164-in. O.D. tubing; 152 lb. for 0.131-in. I.D. by 0.187-in. O.D. tubing; axial compression strength of 17,100 p.s.i.; a density of from 1.20 to 1.25 g./cc.; and a water absorption gain of from 5.10 to 5.65 percent.

Plastic tile mastic

Water-emulsion mastic for wall tile has been announced by McCarten Industries, Inc., Chagrin Falls, Ohio. Designated Super Max-Tic, the mastic is intended for use under conditions of excessive heat and moisture, including areas around water pipes and tub lines.

Urethane protective coating

A paint system for concrete floors, walls, and structural surfaces is being introduced to paint manufacturers by Mobay Chemical Co., St. Louis, Mo. The new coating is based on Mobay's Mondur Multron urethane made with moderately-branched polyester resins reacted with a polyisocyanate, both of which the firm supplies to paint formulators.

According to the company, the urethane coating is superior to conventional proprietary systems in hardness, abrasion and chemical resistance, and appearance. Low dirt retention and easy clean-up, because of the smooth surface film that is characteristic of urethane coatings, are cited as additional benefits. The coating is said to be non-toxic and non-irritating.

Lustrous pearl effect

Introduction of Nacromer YNC, a synthetic which produces a luster that is claimed to equal or exceed the finest grade of natural pearl essence at a fraction of the cost, has been announced by The Mearl Corp., 124 E. 40th St., New York, N. Y.

The material is supplied in concentrated paste form and can be applied by spray, brush, or dip to plastics and other materials. It can also be incorporated into plastics prior to molding.

Lustrous effects can be achieved by the addition of transparent pigments or dyes.

Tool repair kit

Castings and tools can be readily repaired with a kit offered by Houghton Laboratories, Inc., Olean, N. Y. The kit contains two tubes, one holding aluminum-filled epoxy and the other a hardener. One equal length bead from each tube will insure correct proportions, and as much or as little as needed can be used at any one time without damage to the balance of the tubes' contents. Cure is at room temperature.

Release agent reduced

Price reductions for Lunn-Lease, a spray-type film-forming parting agent for reinforced plastics molding, have been announced by Lunn Laminates, Inc., Huntington Station, N. Y. Five-gal. cans have been cut from $4.85 to $4.25 per gal.; in 55-gal. drums, the price has been reduced from $4.15 to $3.80.

Advantages claimed for the release agent are 1) the carrier evaporates almost immediately when sprayed on molds; 2) it leaves a uniform surface said to be non-tacky; and 3) it can be applied as thin as 0.001 inch.

Pipe notes

Broadens base. Seamless Rubber Co., New Haven, Conn., has purchased the plastic pipe fittings firm of E & A Sales, Inc., 4144 E. Washington Blvd., Los Angeles, Calif. E & A currently manufactures approximately 170 different plastic pipe fittings in Kralastic, butyrate, and rigid polyvinyl chloride.

Don Roberts, a veteran of several years in the plastic pipe and fittings field, has been named sales manager of E & A.

Koroseal O.K. for meat packing plants. The U. S. Department of Agriculture has approved the materials used in the manufacture of Koroseal rigid PVC pipe for conveying brine and other liquids in meat packing plants, according to an announcement by B. F. Goodrich Industrial Products Co. As a result, meat packing plants, which had to obtain individual approval for each installation of the pipe, may now install it without first obtaining U. S. Government approval.

Expansion

Union Carbide Corp. will build a plant in Putnam County, W. Va., which when completed in 1960, will be the eighth major chemicals producing plant of the company. The new facility will produce chemicals for the market and supply raw materials for further processing at the South Charleston and Institute plants.

It will be designed for the necessary flexibility to meet changes in the market demands for chemicals as they occur in the future but will immediately start production of ethylene and propylene for Carbide's use. Three of the other chemicals to be made at this plant are ethanol, ethylene oxide, and isopropanol.

Imperial Chemical Industries, Ltd., is planning an expansion program on a 1000-acre site on the Severn in the Thornbury Rural District of central England for the manufacture of organic and inorganic chemicals. If local authorities approve the plan, the total investment in developing the site between now and the mid-1970's is expected to be close to $300 million.

The facilities will rely to a great extent on oil as their main raw material. One of the factors influencing I.C.I. in its choice of the site has been the availability of good port facilities which will be

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able to handle tankers of 30,000 tons capacity that would bring oil direct from the oil fields and the refineries.

Borden Chemical Co. (Canada) Ltd., a wholly-owned subsidiary of **The Borden Co.,** New York, N. Y., and formerly known as **American Resinous Chemicals of Canada,** has started construction on its new $400,000 plant in West Hill, a suburb of Toronto, Ont.

When completed, the facility will produce adhesives and coatings for paper converting and other uses; textile and carpet backings and adhesives; and sundry maintenance materials such as under-coating for cars and asphalt emulsions and cutbacks for driveways. The plant has been designed to permit expansion and diversification into other chemical products at a later date.

Formica Corp., a subsidiary of **American Cyanamid Co.,** is completing a $1.5 million addition to its Evendale, Ohio, plant. The new addition will result in a ten-fold increase in floor space for resin manufacture and will provide a direct supply of resins to Formica treating machines for paper and other raw materials.

American Latex Products Corp., Hawthorne, Calif., announces the construction of the **Freedlander Research and Development Laboratories** as part of an overall development program. The 2-story, 25,000-sq. ft. facility will be erected at a cost of $150,000 and will be devoted to chemical and engineering research on polyurethane and rubber foam.

The Trescott Co., Inc., Fairport, N. Y., manufacturer of the Trescomatic line of weighing and filling machines, has bought the name, good will, patents, etc., of **Niagara Packaging Machinery Corp.** Trescott will continue to manufacture the full line of Niagara equipment and furnish old customers with parts and service. **C. Forrest Richards,** founder of Niagara, has been retained by Trescott as a design engineer.

The latest development of Niagara and the machine for which Trescott is planning large-scale production is an automatic polyethylene bag sealer used in conjunction with either a net weight volumetric or automatic counting head.

Solvay Process Div., Allied Chemical & Dye Corp., announces plans to more than double the capacity of its vinyl chloride monomer operation at Moundsville, W. Va.

Solvay added vinyl chloride to its chemical roster in May 1956 with completion of a plant adjacent to its chlorine-caustic soda and chloromethanes facilities.

Newbury Industries, Newbury, Ohio, manufacturer of Mini-Jector (1/3- to 1-oz. capacity) injection machines, has merged with **R. L. Frohring Machine Co.** and **Glenn Machine & Service Corp.** which in the past have done most of the machine work and engineering for Newbury.

The new corporate unit will be known as **Newbury Industries, Inc.** Officers elected are as follows: **W. O. Frohring,** chairman of the board; **R. L. Frohring,** president; **Glenn H. Frohring,** vice president in charge of engineering; **Charles Lorraine,** vice president in charge of production; and **Charles Lowrey,** vice president in charge of the Plastic Machine Div. **Ted Churchia,** who formerly handled sales, is now with **Bearings, Inc.,** another company in which Newbury is interested indirectly.

Raybestos - Manhattan, Inc., through the purchase of plant and equipment of **The Graef Engineering Co.,** Paramount, Calif., has established a Pacific Coast Div. to manufacture Teflon and Kel-F products. The new division will make a line of Teflon and Kel-F products, including extruded and molded rods and tubes and centerless ground rods, and machined parts from Teflon, Raylon, Kel-F, and nylon. Raylon is R/M's mechanical grade Teflon. In addition, facilities for spray-coating metal parts with Teflon and Kel-F are available.

The Pacific Coast Div. will also stock Teflon sheet, tape, etched tape, expansion joints and couplings, and will supply other items in stress-relieved, X-rayed, and certified grades.

Arthur W. Byxbee, formerly sales manager of R/M's Plastic Products Div., has been appointed general manager of the Pacific Coast Div. **Col. O. K. Graef,** former owner of The Graef Engineering Co., has been named plant manager.

Molded Fiber Glass Body Co., Ashtabula, Ohio, has purchased a 60,000-sq. ft. building which, when fully equipped, is expected to make possible a 150% expansion in the company's productive capacity. The firm produces reinforced plastics parts for the automotive, trucking, and transportation industries.

The new structure is the eighth major expansion for the five Molded Fiber Glass Cos. in the past two years. It now operates seven plants totaling over 350,000 sq. ft. of floor space in three states, plus a new research laboratory in Ashtabula.

Dec-Art Process Co., Inc., has moved from 349 Canal Place, New York, N. Y., to enlarged quarters at 1704 Boone Ave., New York, N. Y. The firm specializes in decorating plastics and other materials.

The new plant is expected to double the company's production facilities, and was designed to include a Research Dept. for solving many of industry's difficult decoration problems.

Hull-Standard Corp., Abington, Pa., manufacturer of transfer and compression molding presses, announces that a new plant building to house expanded manufacturing facilities is nearing completion. The plant, on a 5-acre tract 20

With the wide color range of Styron, identity of processing companies is easily incorporated into these 35-mm slide containers. Snug-fitting lid protects against moisture, keeps each container locked to the next.

Intricate design and complimentary colors in this low-cost compact induce impulse purchases of more than one shade. This is only one of many applications in which Styron excels.

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miles north of Philadelphia, was erected primarily to accommodate the growing backlog of orders for the Hull-Standard Model 99A fully automatic transfer molding press.

Kimball Mfg. Corp., San Rafael, Calif., announces that it is now operating with new and enlarged facilities and increased capacity, enabling the firm to offer custom molding services to interested firms. Kimball molds fibrous glass-reinforced plastics products.

Joseph A. Kaplan & Sons, Inc., fabricator of vinyl film products, has acquired two factory buildings formerly part of the Alexander Smith real estate on Saw Mill River Rd., Yonkers, N. Y. The building will provide approximately 175,000 sq. ft. of floor space.

The company, which produces shower curtains, and men's, women's, and children's rainwear, presently has manufacturing facilities in a 9-story plant at 511 W. 25th St., New York, N. Y., and also operates a fabric printing plant at Norwalk, Conn. Executive and sales offices will remain at 49 W. 33rd St.

Kaplan, in association with **B. F. Goodrich Co.,** pioneered in the development and application of one of the first vinyl materials, BFG's Koroseal, from its inception in 1937.

Stanford Research Institute, Menlo Park, Calif., has established a new $50,000 plastics laboratory. The Institute has been actively engaged in plastics research work since 1950. During the 7-year period, the staff has built up a reservoir of knowledge and capabilities in the field of polymer chemistry. The dollar volume of contract research has climbed commensurately. For the calendar year of 1957, this work will reach $250,000.

The new laboratory provides a centralized facility which houses over $40,000 in equipment. A group of 32 scientists and technicians is engaged in the plastics research program.

The new facility makes available machines to fabricate metal-adhesive-metal laminates, facilities for specimen irradiation, a variety of tensile and flexural strength testing devices, weathering and aging equipment to simulate environmental conditions, and vacuum forming and injection molding machines.

Major areas of plastics research include the synthesis and evaluation of new polymers; study of the effects of high-energy radiation on polymers and the synthesis of polymers amenable to improvement by radiation; and the lamination of plastic films to polyester glass laminates. Other work is in the fundamental development of structural dielectrics for aircraft applications; of plastics for use at high temperatures; of solvent-resisting silicone rubbers; of adhesives for various materials; and of silicone elastomers.

Monsanto Chemical Co. has completed a 10% expansion in St. Louis, Mo., in its production capacity for maleic anhydride, which is an ingredient used in the manufacture of alkyd-based paints and polyester resins.

Approximately 60 million lb. of maleic anhydride are produced yearly in the United States. Prior to the Monsanto expansion, the maleic anhydride unit at the firm's John F. Queeny plant ranked as the world's largest.

The company also announces that it has started two major expansions of the capacity of its integrated petrochemical production facilities at Texas City, Texas. A 40 million-lb. increase in the rated capacity of the styrene monomer plant at Texas City will be completed by June 1958; a 12 million-lb. addition to the plant's acetylene capacity will be completed early in 1958. Acetylene is one of the basic raw materials for the manufacture of acrylonitrile and vinyl chloride monomer, both produced at Texas City.

By-product gas from the acetylene process is the principal raw material for the Monsanto-operated methanol plant jointly owned with **Heyden-Newport Chemical Corp.**

Archer - Daniels - Midland Co., Minneapolis, Minn., has carried out its sixth foreign expansion in less than a year with the construction of a plant to produce plasticizers and synthetic resins in Ruhle, West Germany, near the Holland border. The facility will be operated by **Scado-Archer-Daniels GmbH & Co.,** which is owned by ADM and its German and Netherlands partners.

ADM will license the German company to use its formula and know-how in the manufacture of resins and plasticizers. The firm will also utilize the laboratory and technical staff of **Scado-Archer-Daniels, NV,** a Holland manufacturer of resins and plasticizers in which ADM recently acquired an interest.

National Vulcanized Fibre Co. has placed in operation a new fabricating plant in Los Angeles, Calif., to serve the 11 western states. The facility is equipped to fabricate all National plastics, including laminates, nylon, and vulcanized fibre, and will increase the company's overall fabricating capacity by more than 10 percent.

In addition to the fabricating operation, the new facility will also serve as a central warehouse and as the Los Angeles district office. **John Macadam,** with National for 20 years, will be superintendent and engineering consultant.

Other fabricating plants of the company are located in Wilmington, Del., Chicago, Ill., Johnson City, N. Y., and Toronto, Canada.

Narmco Resins & Coatings Co., Costa Mesa, Calif., has placed in operation a new, multiple-story mixing facility, capable of producing in excess of 100,000 gal. a month of liquid adhesives, lami-

Pyle-Star-Line Connectors with inserts molded of Resinox 3700 green exceed both military and NEMA requirements. They are compact, light in weight, water-proof, gas-proof, shock-proof, dust-proof.

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green is the first phenolic type molding material to meet the very exacting Mil-C-5015-B Specifications for connectors. A low water absorption thermosetting material, it has been formulated to meet the critical requirements of ordnance connectors. It offers excellent arc resistance even under the most extreme environmental conditions. Designed for automatic molding, Resinox 3700 green makes possible better connectors at lower unit costs. Its unusual dimensional stability, including less after-shrinkage, plus superior automatic molding performance, means fewer rejects. Components made from this premium grade Monsanto compound possess exceptional electrical properties with improved impact resistance. For complete data on Resinox 3700 (frequently the *only* thermosetting material that can solve a critical electrical problem), write to Monsanto Chemical Company, Plastics Division, Room 1765, Springfield 2, Mass.

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nating resins, putties, and sealers which will increase the firm's productive capacity in these products by 500 percent.

The installation contains two hot-jacketed mixing churns of 100- and 300-gal. capacity; four cold-jacketed mixing churns, one of 250-gal. capacity; and one Sigma blade mixer of 125-gal. capacity and two of 100-gal. capacity each.

In addition, the unit incorporates four service mixers used for processing resins and elastomeric compounds and a resin kettle that serves to advance the chemical stage of resins during processing. Also included are a variety of portable propeller mixers for limited and experimental runs, as well as pebble mills for special mixing.

Deceased

Donald A. Comes, vice president and general sales manager of **Farrel - Birmingham Co., Inc.,** Ansonia, Conn., died suddenly on July 14. Mr. Comes was well known for his work in connection with the Banbury mixer. He handled the sale of this machine from the early days of its development, starting in 1922 in New Jersey.

Meetings

Plastics groups

August 29-30: The Society of the Plastics Industry, Inc., Meeting of the Policy Committee of the Reinforced Plastics Division, The Greenbrier, White Sulphur Springs, W. Va.

September 27: Society of Plastics Engineers, Inc., Regional Technical Conference, Hotel Niagara, Niagara Falls, N. Y. Subject: "Hot Runner Molding."

October 8: Society of Plastics Engineers, Inc., Regional Technical Conference, Curtis Hotel, Minneapolis, Minn. Subject: "Isocyanates."

October 10-11: The Society of the Plastics Industry, Inc., Thirteenth Annual New England Section Conference, The Wentworth-by-the-Sea, Portsmouth, N. H.

October 17: Society of Plastics Engineers, Inc., Regional Technical Conference, Hotel Carter, Cleveland, Ohio. Subject: "Polyethylene—Properties and Uses."

November 11: Society of Plastics Engineers, Inc., Regional Technical Conference, Ambassador Hotel, Los Angeles, Calif. Subject: "Plastics for Air-Borne Electronics."

December 10-11: The Society of the Plastics Industry, Inc., Eighth S.P.I. Film, Sheeting, and Coated Fabrics Division Conference, Commodore Hotel, New York, N. Y.

Other Meetings

September 8-13: American Chemical Society, 132nd National Meeting. Plastics meetings at Barbizon-Plaza Hotel, New York, N. Y.

September 15-18: American Institute of Chemical Engineers, Meeting, Lord Baltimore Hotel, Baltimore, Md.

September 15-18: Produce Packaging Association, Seventh Annual Produce Packaging Show and Conference, The Shoreham Hotel, Washington, D. C.

September 17-18: Building Research Institute, Meeting of Plastics Study Group, Washington University, St. Louis, Mo. Subject: "Plastic Materials for Roof Construction."

September 24: Packaging Association of Canada, Point-of-Purchase and Technical Institute Seminars, Building Centre, Toronto, Ont.

October 1-3: Armed Services and the National Security Industrial Association, Third Joint Military-Industry Packaging and Materials Handling Symposium, Fort Lee, Va.

October 7-8: Technical Association of the Pulp and Paper Industry, TAPPI Plastics-Paper Conference, Sheraton - Gibson Hotel, Cincinnati, Ohio.

November 20-22: American Society for Testing Materials, Meeting of Committee D-20 on Plastics, Cavalier Hotel, Virginia Beach, Va.

December 2-6: Twenty-sixth Exposition of Chemical Industries, Coliseum, New York, N. Y.

Companies . . . People

Du Pont, Polychemicals Dept.: William M. D. Bryant and **Dr. Warren F. Busse** have been appointed senior scientists, a newly established rank set up to recognize "the highest attainment of creative ability and accomplishment." Mr. Bryant, with Du Pont since 1927, presented the first detailed picture of the structure of polyethylene and was associated with the development of the modern X-ray method for determining crystallinity in polymers. Dr. Busse will continue research on polymers and free radical reactions. **Drs. Northrup Brown** and **Fred W. Billmeyer, Jr.** named senior research chemists, another new classification set up to reward "outstanding performance in execution of research programs." Dr. Brown will pursue studies aimed at more complete characterization of the basic structure of Delrin acetal resin. Dr. Billmeyer will continue his work on the molecular characterization of polymers, which has led to the development of new instrumentation and control tests for plastics. **Dr. Bernard M. Marks** promoted from research associate to senior research associate. He will follow work in the field of new polymers and chemical reactions related to plastics. **Laurits T. Muus, Yoh-Han Pao, Howard W. Starkweather, Jr.**, and **John P. Tordella** named research associates. Dr. Muus has worked on the structure and physical properties of polymers. Dr. Pao has been studying the relations between the structure of polymers and their physical properties; Dr. Starkweather will be responsible for studies on the properties and mechanical behavior of plastics; and Dr. Tordella will work on studies of the flow of molten polymers.

Film Dept.: Mylar polyester film technical section established at the Circleville, Ohio, plant for process and technical development work. **Dr. Jake T. Nolen,** assistant manager of the Circleville plant since it began the first commercial production of Mylar three years ago, appointed manager of the section. **Walter O. Simon** appointed assistant general manager of the Film Dept. He succeeds **Arlington Kunsman** who has retired after nearly 41 years with the company. **Dr. Edgar W. Spanagel,** with Du Pont since 1933 and formerly assistant director of production, succeeds Mr. Simon as director of production.

Monsanto Chemical Co.—Plastics Div.: Robert R. Moyer, manager of technical service, styrene molding materials, promoted to assistant director of technical service; he replaces **Ivan V. Wilson,** named patent consultant for the Springfield laboratories of the division's Research Dept. **Bennett Nathanson** succeeds Mr. Moyer as manager of technical service, styrene molding materials. Mr. Moyer will supervise technical service activities in five product areas: styrene molding materials, surface coating resins, industrial resins, textile and paper resins, and, for eastern operations, adhesives.

Goodyear Tire & Rubber Co.—Chemical Div.: Robert S. Savage, named special representative at the Boston district office, will provide service for products marketed by the Chemical Div.'s Plastics, Coatings, and Rubber Depts. in the New England area.

Goodyear International Corp.: New chemical division has been established. Sales policy and direction of the new division will be the responsibility of **Herman R. Thies,** general manager, Chemical Div., who will report to **F. T. Magennis,** president of Goodyear International, on overall progress and results. The new division will handle all matters relative to overseas sales of synthetic rubber, rubber chemicals, plastic raw materials, and coating raw materials.

R. E. Workman appointed manager of the division; he is on a one-year leave of absence, during which time **R. S. Earhart,** assistant general sales manager of the parent company's Chemical Div., will be acting manager. Appointed to home office positions are **J. S. Amrein** as administrative assistant and **O. R. Gillen** as manager of technical services.

W. D. Porter appointed sales manager-Europe with headquarters in London. Four field representatives have been assigned to the European area—**G. H. Campbell** to Munich, Germany; **J. H. Drexler** to Cologne, Germany; **F. W. Milward** to Paris, France; and **C. S. Pyne** to Brussels, Belgium. **N. P. Wileman** named field representative for the Far Eastern area and **P. A. Colgate** has been assigned to the same post for the Western Hemisphere area. Both appointees will headquarter in Akron, Ohio.

Hooker Electrochemical Co.: Dr. Thonet C. Dauphine, with the company since 1951, appointed manager of product development—plastics; **Carl I. Gochenour,** with the firm since 1944, named manager of product development—chemicals. **James S. Sconce,** with the company since 1930 and formerly manager of chemical research, appointed to the newly created position of technical assistant to management.

New district sales office opened at 6 Penn Center Plaza, Philadelphia, Pa., with **Neil M. Barber** as district sales manager and **John J. Wojnar** as manager of the new office.

Durez Plastics Div.: John P. Edwards, with Hooker since 1947, named sales manager of Hetron polyesters; he replaces **Charles Y. Cain,** appointed administrative assistant to **Alfred W. Hanmer, Jr.,** general sales manager.

American Society for Testing Materials: Awards of Merit were presented to the following: **Albert George Henry Dietz,** Professor of Building Engineering and Construction, **Massachusetts Institute of Technology,** in recognition of constructive leadership in the work of Committee C-19 on Structural Sandwich Constructions, for notable contributions on Committee D-20 on Plastics, and to other ASTM activities; **Frank Walter Reinhart,** Chief, Plastics Section, **National Bureau of Standards,** in recognition of productive service of broad scope in ASTM technical work, strong leadership including committee chairmanships, and outstanding contributions to the Society through research and standards covering especially plastics and adhesives.

Blaw-Knox Co.—Chemical Plants Div.: Benjamin D. Russum, with the firm since 1942, promoted to manager of reorganized Midwest Headquarters at Chicago, Ill., which provides engineering, design, material procurement, and construction services for the chemical, petroleum, and other process industries of the midwestern and southern states. **Dr. Hal B. Coats,** a veteran of 15 years with the company, named assistant manager. **William W. Lawrence** promoted to manager of the General Chemicals Dept.

Thiokol Chemical Corp.: Henry James O'Neil, formerly with Gates Engineering Co., named technical sales representative for Indiana, Michigan, and Ohio. **Francis Edward Klemm,** previously with Kelite Corp., appointed technical sales representative for polyurethane resins. **Ernest Ray Sutton, Jr.** now technical sales representative in the Chicago territory.

Shawinigan Resins Corp.: Samuel T. Douglas, Jr. appointed to New England district sales office and **David H. Cahill** to the Technical Service Dept. The company manufactures a line of vinyl acetate, alcohol, butyral, and formal resins.

B. F. Goodrich Co.: William R. Todd, vice president of the **Sponge Products Div.** for 34 years, named president of the division. He succeeds **F. M. Daley** who has retired. The division presently manufactures open and closed cellular plastics, polyurethane, rubberized hair cushion-

Companies . . . People

ing, chemically blown sponge rubber, and foam rubber.

B. F. Goodrich Chemical Co.: Robert L. Toole now head of the Production Dept. at the Niagara Falls, N. Y., plant, where BFG Chemical Geon vinyl resins are produced. He replaces **Dan C. Campbell,** recently transferred to the Project Engineering Dept. at Cleveland, Ohio. **Charles L. Gillingham** named junior sales representative of plastics materials, working out of the Cleveland district office.

Celanese Corp. of America—Plastics Div.: R. K. Thomson, with the firm since 1943 and assistant district manager since 1954, appointed New England district sales manager; he succeeds **S. W. Murray,** now on a special marketing assignment for the general sales manager.

W. R. Grace & Co.—Polymer Chemicals Div.: Drs. Andrew J. Foglia, Frederick C. Foster, and **Roger M. Weil** named research chemists in polymer research and development.

Food Machinery & Chemical Corp.—Becco Chemical Div.: William H. Kibbel, Jr., with the company 10 years, appointed to newly created position of manager—market research. **Vernon E. Moore,** formerly West Coast sales representative, promoted to manager of the West Coast territory.

Allied Chemical & Dye Corp.—Barrett Div.: Stanley B. Mulder, formerly Toledo representative, appointed midwestern district manager of Plaskon industrial resins sales. **Thomas A. Bennett** succeeds Mr. Mulder as Toledo representative.

National Aniline Div.: Neal M. Draper, with the company 22 years and formerly assistant director of sales of the **Solvay Process Div.,** named assistant to the executive vice president.

L.O.F. Glass Fibers Co., Corrulux Div.: Four new distributors appointed: **Westport Building Material Co.,** Springfield, Mo.; **Ross Frazer Supply Co.,** St. Joseph, Mo.; **Kane Steel Co.,** Millville, N. J.; and **Braden Mfg. Co., Inc.,** Terre Haute, Ind. **H. Matthew Bowers,** general quality control manager of L.O.F., promoted to process control manager of Corrulux Div., Houston, Texas. He is succeeded by **John R. Meeker,** formerly supervisor of quality control at the Defiance, Ohio, plant.

The Dow Chemical Co.: Dr. William H. Schuette, general manager of the Midland Div. since 1955, elected to the board of directors. He has been associated with Dow since 1941 and was active in the production of Styron polystyrene and Styrofoam. **Paul M. Jensen,** 24 years with the company and supervisor of plastics sales at the Detroit office since 1944, will now handle special sales assignments in connection with molding materials. He is succeeded in his Detroit post by **John E. Donalds,** formerly coatings salesman at Cleveland.

New sales office opened at 1 Gateway Center, Pittsburgh, Pa. **Donald H. Gilmore,** with the firm since 1946, named manager.

Sartomer Resins, Inc. is the new corporate name of the company formerly known as Specialty Resins, Inc. The firm also announces that its manufacturing facilities have been relocated from Chicago to larger facilities at Essington, Pa. The main office remains at Philadelphia, Pa. The company manufactures custom monomers and polymers.

Hercules Powder Co., Inc.: Arthur C. Ketcham, Jr., with the company 10 years, transferred to the Wilmington branch office as senior technical representative; **William L. Kitchel** now technical representative at the New York branch office; **Joseph O. Bradford** assigned to the home office in Wilmington as technical representative working on sales promotion of pentaerythritol.

Spencer Chemical Co. has opened a West Coast polyethylene sales office at 1435 S. La Cienega, Los Angeles, Calif., to service California, Oregon, Washington, Arizona, and Nevada. **C. W. "Bill" Brooks** named to direct its activities. Warehouse facilities will also be maintained.

Campro Co., Canton, Ohio, custom molder, has relocated on a 19-acre site located on the Canton-Alliance Highway. **Gene Licklider,** formerly with Skotch-Hamilton Corp., named production manager. **Glen Barnett,** product designer previously with Diebold, Inc., and the design consultant firm of Industrial Service Co., appointed chief engineer. **Ira A. "Ike" Abernathy** named superintendent of assembly and finishing operations. **Robert Arner** promoted to head of purchasing and traffic and **Joe Yakubik** to superintendent of molding operations.

Chicago Molded Products Corp.—Campco Div.: E. W. Hunnicutt named New England district sales representative.

Custom Molding Div.: Ray Geisler, named midwestern sales representative, will handle application engineering and sales for the company's compression and injection molding facilities. **Richard A. Paisley** appointed sales and application engineering representative for Ohio. He has been handling sales for Campco thermoplastic sheet materials. Now Mr. Paisley will also handle application engineering and sales for the division's injection, compression, and transfer molding facilities.

Capital Plastics, Inc., Rochester, N. Y., manufacturer of molded pearlescent buttons and other products, has formed a Belgian subsidiary, **Capital Plastics Europe S.A.** in Brussels to serve the western European market. The European company will start operations as a sales and service organization and will draw upon an inventory at Antwerp. In its second stage, the Belgian firm will engage in processing and finishing. Eventually, it will manufacture synthetic pearl material.

Robbins Plastic Machinery Co., Elkhart, Ind., has contracted to sell the company to **Lynch Corp.** Robbins will expand Lynch's manufacture of automation machinery.

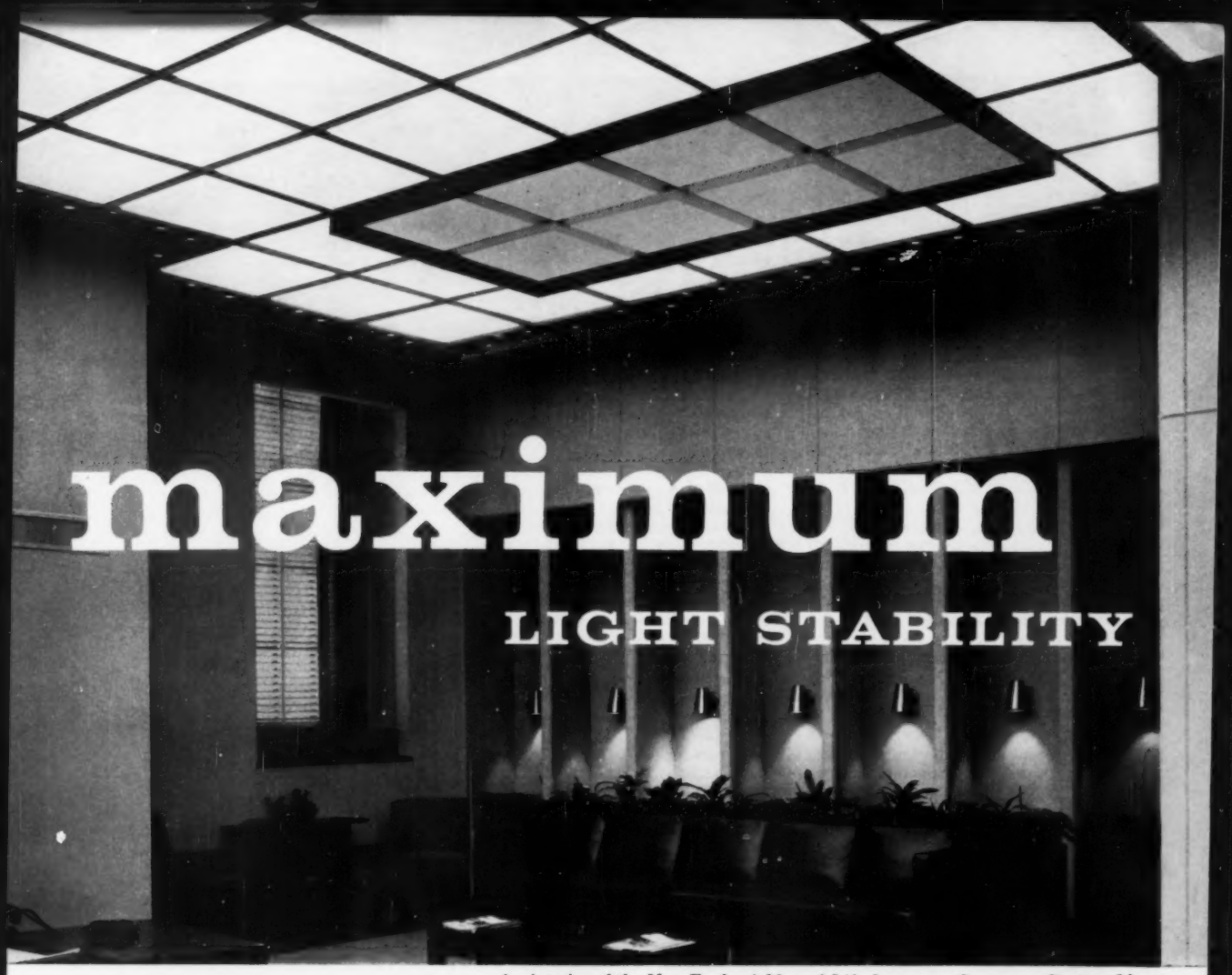
Universal Hydraulics Machinery Co., 285 Hudson St., New York, N. Y., and **Johnson Machinery Co.,** 683 Frelinghuysen Ave., Newark, N. J., which rebuild machinery for plastics processing have consolidated their operations, according to a joint announcement by **Mrs. Irma Sacks** and **Mayer A. Rubenstein,** respective presidents of the companies. The combined organizations will operate out of Johnson's 16,000-sq. ft. Newark plant, which includes sales, rebuilding facilities, and showroom. In addition, 62,000 sq. ft. of storage space is maintained next to Newark Airport to house the combined inventories.

The Barden Corp., Danbury, Conn., licensed by **Polymer Processes, Inc.,** a subsidiary of **The Polymer Corp.,** to manufacture ball bearing retainers from Nylasint finely divided nylon powder. (See p. 157 of this issue for details on properties of sintered nylon).

Niagara Machine & Tool Works has established a new Boston district office in Waltham, Mass., with **Robert F. Gaylord** as manager. The firm manufactures presses and shears for the plastics and other industries.

Robertshaw-Fulton Controls Co., manufacturer of automatic controls, has moved its executive offices from Greensburg, Pa., to Richmond, Va.

Chemtrol Corp., Compton, Calif.: **Don Jenson,** appointed chief engineer, will supervise all engineering activities on corrosion service plastic



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Sylva-lume, Sylvania's newest over-all lighting system, is composed of economical standardized components of white or tinted rigid vinyl. They come in a variety of types and offer many design possibilities. The translucent pink-tinted rigid vinyl panels, 3-ft. square, are *Nixon sheet material* vacuum formed by *Piolite Division of Pioneer Plastics Corp., Peabody, Mass.*, for *Sylvania Electric Products Inc., Wheeling, West Virginia.*

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Companies . . . People

valves and piping systems, and direct research and development of new valve designs and other products. **Newton R. Crum** named regional sales manager for the 11 western states.

Universal Unlimited, Inc., formerly Steiner Universal Corp., announces that it has acquired all operations formerly conducted by **Steiner Plastics Mfg. Co., Inc.** Manufacturing facilities will continue at the present location, Pratt Oval, Glen Cove, N. Y.

Nalge Co., Inc., Rochester, N. Y., named exclusive master distributor for both U. S. and foreign sales of its stock line of clear flexible vinyl tubing by **Vogt Mfg. Corp.** The tubing will be distributed under the trade name Nalgon and will be identified as a Voplex product. The distribution set-up of Vogt will be taken over and consolidated with that of Nalge.

Commercial Solvents Corp.: James McInnes, Jr., with the company since 1933, named manager of the New York district sales office; he succeeds **Arthur W. Luedeke**, who now heads the Mid-Atlantic office at Newark, N. J.

The Electric Storage Battery Co.: Roland Whitehurst, with the company since 1908, vice president since 1948, and a director of the firm since 1951, elected president of **Jessall Plastics**, a subsidiary at Kensington, Conn. He continues as head of Exide Industrial Div. **Monroe G. Smith** appointed general manager of **Exide Industrial Div.**, a position relinquished by Mr. Whitehurst because of his added responsibilities at Jessall. **William C. Leingang**, a veteran of almost 35 years with the company and former assistant to the president, named general manager of **Stokes Molded Products Div.** at Trenton, N. J. He will continue as a member of the management committee of the company.

Sylvania Electric Products, Inc.: Louis R. Wanner, formerly plant manager of plastics operations, named manufacturing manager of plastics, metal base, assembly, and formatic operations. **Ned W. Spangler**, formerly division industrial engineer at the Warren, Pa., plant, appointed manufacturing superintendent of the plant.

Tracerlab, Inc., has established a new sales office at 7122 Jamieson Ave., St. Louis, Mo., to serve neighboring territories. John Eills is in charge. **Joseph P. Beyer** appointed sales representative at the Los Angeles office. **Charles B. Mead** named sales representative at the Detroit office. **Thomas L. Kelley** named nuclear sales manager. Tracerlab manufactures a line of beta gages and other nucleonic control equipment used in the plastics and other industries.

Heyward-Robinson Engineering Co. has moved from 2015 Avenue U, Brooklyn, N. Y., to 114 Liberty St., New York, N. Y. The company, a diversified engineering organization specializing in the industrial and chemical fields, handles plant and process design as well as construction.

The Carpenter Steel Co. has opened a new mill-branch warehouse in Detroit, Mich., to service users of specialty tool, stainless and alloy steels in the state of Michigan. It replaces an older and smaller facility which the company has operated in Detroit since 1927. Managing the warehouse operation are **Carl O. Ericke**, district manager; **O. T. Thompson**, branch manager; and **John S. Stevens**, warehouse manager.

Electronic Plastics, Inc., Matawan, N. J.: Following sales representatives named: **Art Cerf & Co.**, Newark, N. J., **Frank C. Nickerson**, Atlanta, Ga., **Mosher & Peyser Co., Inc.**, Needham, Mass., for the New England states. The firm manufactures Electroplast, high-temperature wire and molds, and molds electronic components.

Synthane Corp.: Frank C. Abbot, formerly with Reichhold Chemicals, Inc., and Bakelite Co., appointed Texas-Oklahoma sales representative. He succeeds **F. C. McCamly** who has retired after 21 years service with the company. **John W. Decker**, formerly eastern district sales representative for Neilson Chemical Co., has joined the Detroit office.

Gaylord Packaging Corp. has opened a new plant at 120 Leuning St., S. Hackensack, N. J., to produce high-impact polystyrene sheets, specializing in Cycolac and Implex. Principal officer is **Helmut Bothe**, formerly with Du Pont.

Disogrin Industries, Inc., manufacturer of Disogrin, a urethane material, is the new corporate name of the company formerly known as Greer Industries, Inc. The affiliation of the firm with **Greer Hydraulics, Inc.**, has been terminated.

Chief operating officer of Disogrin is **Robert E. Williams**, former operational manager of Greer Industries. Company headquarters remain at New York International Airport, Jamaica, N. Y.

The Mearl Corp., producer of natural and synthetic pearl essence, has moved its executive offices to 217 N. Highland Ave., Ossining, N. Y. Sales, Export, and Technical Depts. are located at 124 E. 40th St., New York, N. Y.

Durable Formed Products, Inc., 6 Greene St., New York, N. Y., announces that in conjunction with its "working agreement" with **Speck Plastics, Inc.** (See MODERN PLASTICS, 33, 260, May 1956), the company will open an Easton, Pa., Manufacturing Div.

National Association of Plastic Fabricators, Cleveland, Ohio: All board of director members re-elected at the first annual meeting recently held in New York. Chief officers are: president—**M. E. Soderstrom, Northway Products Co.**, Rensselaer, Ind.; vice president—**Arnold J. Gold, Topcraft, Inc.**, Baltimore, Md.; secretary—**H. P. Henningsen, Henningsen & Folsom**, Berkeley, Calif. **Arthur J. Tuscany, Jr.**, will continue as executive secretary.

NAPF is composed of manufacturers of finished surface covering products using decorative plastic laminate, such as counters, cabinet tops, vanitories, furniture surfacing, and other domestic and commercial installations.

G. Felsenthal & Sons, Inc.: Nine new offices and four manufacturer's representatives have been added to the sales organization: The offices and their managers are: **Thomas A. Perrott**, 3305 N. Pershing Dr., Arlington, Va., will represent Felsenthal's Research and Development Div. in Washington, D. C.; **Noel Crouch, R. R. Noland Co.**, 718 McKnight Bldg., Minneapolis, Minn.; **Emerson Johnson**, 3401 Wheelock Dr., Racine, Wis.; and **Maury E. Bettis Co.**, 406 W. 34th St., Kansas City, Mo. Felsenthal is a plastics fabricating and injection molding firm.

Dr. Herbert A. Pohl, of the **Du Pont Experimental Station**, has been appointed to the staff of **Princeton University** as Lecturer and Research Associate under the Plastics Program. He will be group leader of the Dielectrics Research Section and lecturer in a graduate course in dielectric polymers.

Jerome Moeckenhaupt has been appointed vice president in charge of sales of **Tri-State Molding Co.**, Henderson, Ky. He was formerly sales manager of Victory Mfg. Co., Chicago, Ill.

Ray Dubrowin, director of point-of-sale merchandising of **Printing &**

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3 GREAT
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An intermediate molecular weight resin with qualities never before available in a single resin for supported and unsupported film and sheeting.
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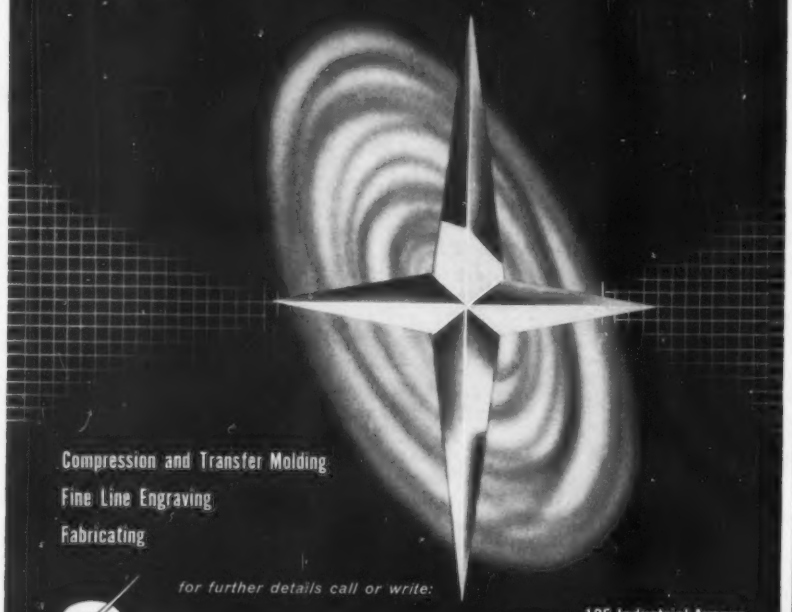

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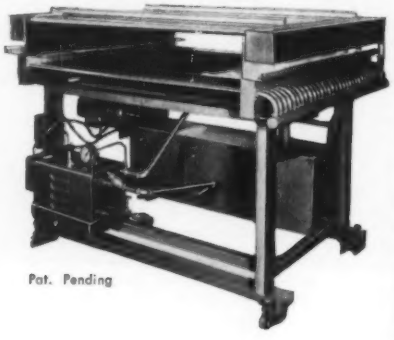

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This Goulding unit produces glazed sheets that retain gloss finish after vacuum forming, without impairing physical properties.

Upper section of unit contains heating elements arranged to supply heat in sufficient intensity to flow the top surface only, producing the gloss finish.

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Companies... People

Lithograph Co., will serve as general chairman of the **Point-of-Purchase Advertising Institute's** 12th annual symposium and exhibit, scheduled for next April 15, 16, and 17 at the Sheraton-Astor Hotel, New York, N. Y.

Morris A. Kimmel, appointed New England sales representative for **Colton Chemical Co.**, will handle polyvinyl alcohol, polyvinyl acetate emulsions, copolymer emulsions, and polyvinyl acetate beads for the adhesive, textile, ceramic, paint, leather, paper, and other industries.

James W. Simmons named sales manager of **H & R Industries**, Nazareth, Pa. The company is an extruder and molder, and produces heavy- and light-gage polyethylene sheet.

Arthur J. Warner appointed director of research of **Mycalex Corp. of America** and associated companies. He will be responsible for materials and product development in an expanded program to be initiated by Mycalex in electronic components, as well as glass-bonded mica, ceramoplastic insulation, and synthetic mica.

Lawrence G. Lane, former production and management executive of Richardson Co., has joined **Fabricon Products** as vice president in charge of operations for the West Coast Plastics Impregnating, Laminating, and Automotive Divs. at Los Angeles, Calif. He will assume direct management responsibility for the development, manufacture, and marketing of all products produced by the firm's three western divisions. These include the Lamin-Art line of decorative laminates; resin-impregnated papers, fabrics, glass cloth, and other materials for molding and laminating electrical, electronic, mechanical, and structural components.

Fabricon Products is a division of **Eagle-Picher Co.**, River Rouge, Mich.

Dickran Yeghiayan, formerly with Formica Corp., named chemical engineer of development and research of **The Glastic Corp.**, Cleveland, Ohio. He will be concerned with low-pressure laminates for electrical insulation. The company manufactures laminates, molded parts, extruded shapes, and U-wedges.

Stanley Weiss appointed southeastern district sales representative for **Southbridge Plastics Div., Golding Brothers Co., Inc.** He will handle Southbridge's vinyl fabric line.

Wheelabrator Corp.: James F. Connaughton elected to new post of executive vice president. **Harold M.**

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Eight important charts summarize technical data on plastics films, adhesives, coatings, solvents, plasticizers and other vital topics. The Plastics Properties Chart, perhaps the most referred-to section of the Encyclopedia, measures 52" x 28" and is suitable for wall mounting.

Companies ... People

Miller, a vice president since 1944, advanced to senior vice president. The firm makes plastics finishing equipment.

Donald B. Ladd has joined **UBS Chemical Corp.**, Cambridge, Mass., to establish a Commercial Research Dept. The company produces coatings, adhesives, emulsions, and resin latices.

Gordon P. Hungerford appointed vice president of **Kordite Co., Div. of Textron, Inc.** He will head up all research and engineering activities. The company fabricates polyethylene film bags and sheet and manufactures and distributes plastic clothesline, brooms, and refrigerator containers.

E. W. Kistner named Chicago branch manager of **Arthur Colton Co.** The firm manufactures blenders, granulators, mixers, preforming presses, and drying and preheating equipment.

Sprout, Waldron & Co., Inc.: Richard Farrell, formerly with Naugatuck Chemical, appointed assistant to **J. L. Grahek,** sales manager of the Pellet Mill Div. **Brown Jenkins** named project engineer. In addition to pellet mills, the company makes blenders, choppers, mixers, and granulators.

Robert W. Campbell appointed sales manager of **Philadelphia Insulated Wire Co.** The company produces insulated wires and cables for the electronic and electrical fields, including Teflon insulated hook-up wires.

Stanley M. Freeman, vice president of **Witco Chemical Co.,** appointed director of sales of the Organic Chemicals Div.

Wendell E. Smith, formerly with Borden, named New Jersey sales representative for **Atlas Powder Co.'s** Thermaflow reinforced plastic molding compounds.

Ralph W. Spencer named sales manager of **Chemo-Textiles, Inc.,** W. Warwick, R. I. The firm produces vinyl-coated glass yarns for window screening, vinyl-, Teflon-, and silicone-coated glass yarns for the electrical industry, and Teflon tape for the electrical and electronic industries.

William H. Willert named a vice president of **Frank W. Egan & Co.,** Somerville, N. J., manufacturer of machinery for the plastics and paper converting industries.

Don Henderson appointed southern Louisiana regional sales manager for

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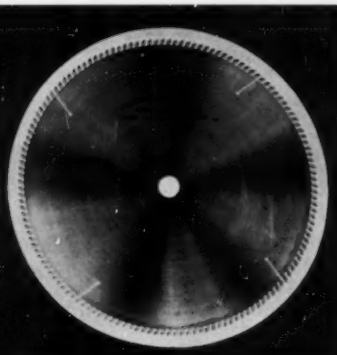

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GERING
Products, Inc.

Companies... People

Tubular Lining Corp., Houston applicator of plastic linings for oil field tubing.

George C. Sheldon named operating manager for the Peabody operation of **Borden Chemical Div.**'s Coatings and Adhesives Dept.

John J. Philbin named regional manager of polyurethane foam sales for **The General Tire & Rubber Co.**

Thomas H. Boyd, formerly with Pittsburgh Coke & Chemical Co., now New York district sales representative for the Chemical Div. of **General Mills**. He will be responsible for sales of the company's Versamid polyamide resins, fatty acids, fatty methyl esters, and sterols.

Baldwin - Lima - Hamilton Corp.— Hamilton Div.: H. J. Weber & Co., Chicago, Ill., appointed a distributor for northern Illinois, southern Wisconsin, and northern Indiana. The firm will sell Hamilton mechanical and Baldwin hydraulic presses, including plastics and metal powder compacting types. **Ogden R. Adams, Inc.**, named Rochester, N. Y., area sales distributor.

Frank E. Gruber appointed vice president of **Brown & Bigelow's** new Research and Development Div. He has been with B & B's Technical and Production Dept. for 24 years and will continue as president of **Herb-Shelly, Inc.**, a polyethylene bag and liner manufacturing subsidiary at Farmington, Minn.

L. J. Anderson appointed sales manager of **Federal Tool Corp.'s Industrial Molding Div.** He was formerly a sales engineer with Victory Mfg. Co., Chicago, Ill.

Jerome Kurtz appointed technical service engineer of **Ferro Chemical Corp.**, subsidiary of **Ferro Corp.**, Bedford, Ohio. He will furnish technical assistance to users of Ferro's PVC stabilizers.

Dr. Robert G. Cheatham, formerly vice president in charge of engineering and research of Larc Products, Inc., named director, Plastics Div., **D. S. Kennedy & Co.**, Cohasset, Mass. The company manufactures large microwave antennas. The Plastics Div. has been slated for expansion into other fields in addition to its present function of making antenna components.

Guy A. Pederzani appointed superintendent of the Coating Div. of **Nashua Corp.**, succeeding the late **Lester R. Hill.**

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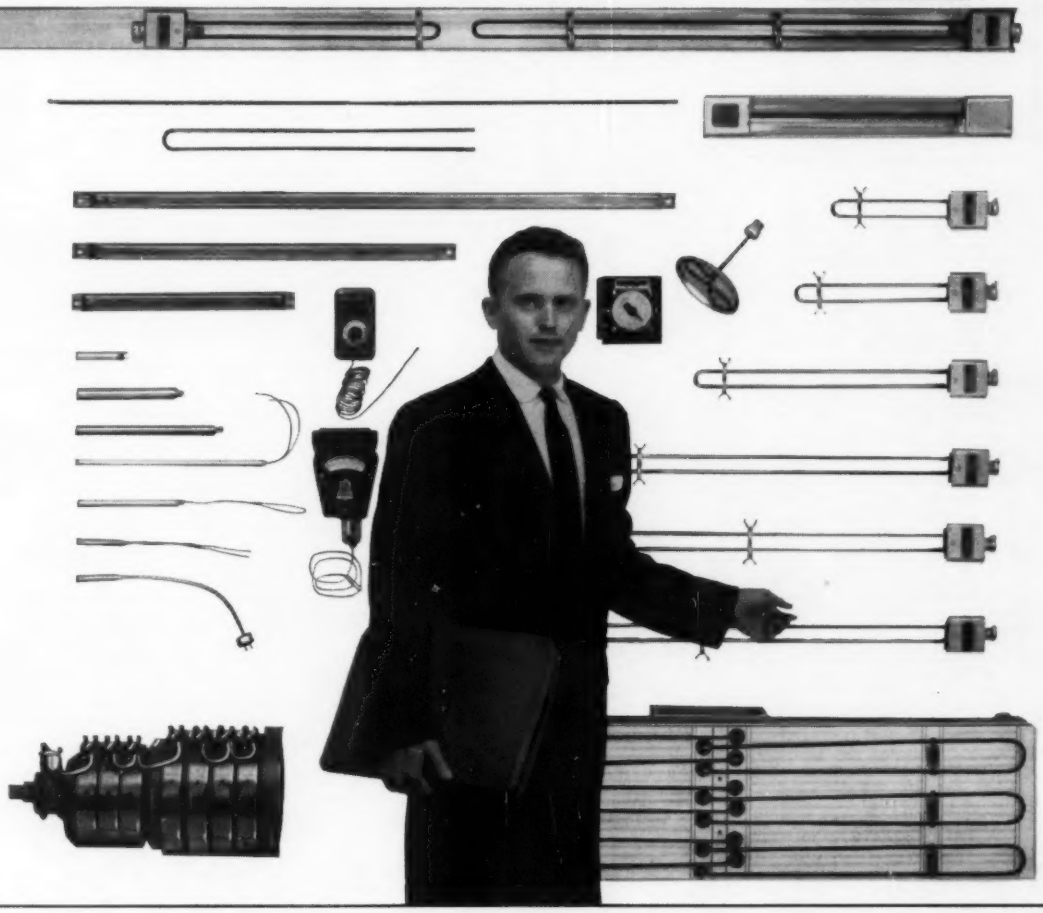

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No matter what heating problem you have, there's a Chromalox electric heating unit of the type and size you need.

Your Chromalox Representative—the man with the answers to your heating problems, routine or unusual—can provide you with the plastic industry's only complete heating line.

Over 15,000 standard types, sizes, and ratings to choose from—plus a complete range of controls and accessories—give you the best answer for your specific job. For instance . . .

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C-2128

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Classified Advertisements

EMPLOYMENT • BUSINESS OPPORTUNITIES • USED OR RESALE EQUIPMENT

Machinery and equipment for sale

FOR SALE: Surplus equipment—Injection Molding Machines up to 60 oz.—Compression Molding Presses—50 ton 12" x 12" Laboratory Presses—Carver Laboratory Presses rebuilt and guaranteed—6" x 13" Laboratory Mills—¾" Double Solenoid Control Valves 3000 psi—Partial List—Send us your inquiries. Plastic Machinery Exchange, 426 Essex Avenue, Boonton, N. J.—Telephone DEerfield 4-1615.

FOR SALE: (6) 100 ton, 10" ram, 10" stroke @ $1250; (7) 200 ton. 9" stroke, 14" ram, 36x36, @ $2150; (6) 200 ton, 9" stroke, 15" ram, 30x30 @ $1850; (1) ton complete, 18x18 @ $1850; (1) 200 ton 16" ram, 30x30 @ $2450; (2) 200 ton 16" ram, 42x42 @ $2850; (1) 200 ton, 15" ram, 42x42 @ $2600; (3) 250 ton (2) 12" ram, 30x60 rebuilt @ $3675. Hydraulic Sal-Press Co., Inc., 386-90 Warren Street, Bklyn, N.Y.

FOR SALE: 8 Stokes "R" "DD2" and "RB2" Single Punch & Rotary Tablet Presses, vari-speed, motor driven. 2 Fitzpatrick Model "D" stainless steel Comminuting Machines with 7½ H.P. Motor. Abbe #00 Rotary Cutter 3 H.P. Motor. Powder Mixers, Sifters, etc. We are interested in your surplus machinery. The Machinery & Equipment Corp., 293 Frelinghuysen Ave., Newark, 12, N.J.

FOR SALE: 1-Baker Perkins size 15USE, 100 gal. all stainless double arm Vacuum Mixer; 1-Baker Perkins size 15VUMM. 100 gal. double arm Mixer, 100 HP motor; 6-day 250 and 100 gal. double arm Mixers; 1-Ball & Jewell #1 Rotary Cutter; 2-Two Roll Mills 6"x12"; 6-Stokes Model DD2, DS3, D3 and B2 Rotary Preform Presses; 4-Stokes Model "R" single punch Preform presses; 1-Kux Model 15-25 Rotary Preform Press; Also: Sifters, Banbury Mixers, Powder Mixers, etc., partial listing; write for details; we purchase your surplus equipment; Brill Equipment Co., 2407 Third Ave., New York 51, N.Y.

LIQUIDATION
Transfer Molding Presses, late type, self-contained
1—300 ton Stokes
2—200 ton Baldwin-Southwark
2—150 ton Stokes
1—100 ton Stokes
6—Thermall Preheaters.
Reply Box 2617, Modern Plastics.

AVAILABLE AT BARGAIN PRICES: Pneumatic Scale Packaging Unit consisting of Carton Feeder, Bottom Sealer, Top Sealer and Filling Units. Both 30 and 60 per minute. Baker Perkins 50 gallon Steel and Stainless Steel Steam Jacketed Heavy Duty Mixers with Stainless Jacketed Blades, motorized power tilting, motor driven. J. H. Day from 1 qt. to 150 gal., Imperial and Cincinnatus D.A. Jacketed, Sigma Blade Mixers. Day 15 to 10,000 lbs. Dry Powder Mixers. Package Machy. FA, FA2, FA4, Miller, Hayssen, Scandia, Hudson Sharp Wrappers. Mikro Bantam. 1SH. 1F, 2TH, 3TH Pulverizers. Day, Rotex, Tyler-Hum-mer, Great Western Sifters. Complete details and quotations promptly submitted Union Standard Equipment Co., 318-322 Lafayette St., New York 12, N.Y.

FOR SALE: 2500 ton downstroke 54" x 102". 800 ton laminating press with 23 openings 26"x38". 600 ton Baldwin downstroke 32"x36". 300 ton Multi opening 40"x40" platens. 300 ton upstroke press 22"x35". Elmes 200 ton 28"x26". Farrel 200 ton 30"x30". 200 Ton Hobbing Press 18" x14". Farrel 200 ton 20"x80". D & B 140 ton, 36"x36". French Oil 120 self-contained 18"x22". Adamson 80 ton 20"x20". Also Lab. to 2500 tons from 12"x12" to 48" x48". Hydr. Pumps and Accumulators. Stokes Automatic Molding Presses. Van Dorn 1 oz. Injection Molding Machine. Mills and Calenders to 84". Seco 6"x13" and 8"x16" Mixing Mills and Calenders. Plastic and Rubber Extruders. Oxford 57" Slitter. Rotary and single punch Preform Machines, ½" to 4". Injection Molding Machines 1 oz. to 60 oz. Baker-Perkins & Day Jacketed Mixers. Plastic Grinders. Gas Boilers. Partial Listing. We buy your surplus machinery. Stein Equipment Co., 107-8th Street, Brooklyn. New York.

FOR SALE: 64 Oz. Injection Molder with Pre-Plasticizer, mold size 32"x50" 750 Ton clamp. Lester 8 oz. Model 2 ½L (1949). De Mattia 12 oz. (1946). De Mattia 4 oz. H.P.M. Rubber Injection molders, 21½" x28" mold space. steam heated platens. Watson Stillman 300 Ton Semi-Automatic Compression molding Press (1947) self-contained, mold size 34"x27". Watson Stillman 250 Ton 28"x24". Watson Stillman 140 Ton 22"x16". Waterbury Farrel 85 Ton 20"x24". W.F. 63 Ton 15"x15". Laboratory Presses—Elmes 20 Ton 8"x8"; others 15 Ton 10"x8" and 10 Ton 6"x6" Platens. Scrap Cutters, Valves, Accumulators, Hydraulic Presses—all sizes. Aaron Machinery Co. Inc., 45 Crosby St., New York, N.Y. Tel.: WAlker 5-8300.

FOR SALE: One 9-oz. 1947 HPM injection molding machine—excellent condition. Reply Box 2616, Modern Plastics.

FOR SALE: Vacuum Metallizer 36". Injection Presses: 12 oz. Reed. 4, 9, 16, 20 oz. HPM. 8 oz. Lester. 6,12 oz. Watson. 2½ oz. Moslo, mod. 72.—1 oz. Van Dorn. —Extruders: 3" Bandera. Stokes Windsor Twinscrew RC 100. 3½" oil heatd. NRM. 24", 30" Sheet Dies. 30", 52" Pull-Offs. 48" Stacker. 14", 36" Dulmage Meter Pumps. Despatch 48"x72" Sheet Preheat Oven. Leominster 5HP Scrapgrinder. Apex 2 color Container Imprint mach.—Compression Presses 50 to 600 T. Elmes 30 T. Hydrolairpress. Stokes 280 G Preform press. Colton 5½ T Preform press—Baker —Perkins 200 Gall. Mixer. 42 cub ft Robinson Ribbon Mixer. Vacuum Forming Mach.: 24x36" and 40x60". Dake 200 T Trimming Press. List your surplus equipment with me.—WANTED: 50 T. Stokes Standard Comp. press 24 oz. 32 oz HPM or Watson. 1½ to 4½" Extruders. Justin Zenner, 823 Waveland Ave., Chicago 13, Ill.

FOR SALE: 2 oz. Van Dorn 1953, lever; 2 oz. Van Dorn 1952, semi-aut; 2 oz. Reed-Prentice, $1500; 4 oz. Impco. 1951. $5500; 4 oz. Reed-Prentice 1946, $4,000; 4 oz. Lewis, 1953; 4 oz. Moslo, 1956; 4 oz. Pecos w/8 oz. cyls. 1957; several 8 oz. Reed-Prentices. 1946/1951, $5500. up; 8 oz. Watson-Stillman; 8 oz. DeMattia; 8 oz. Lester; 12 oz. DeMattia, Model C, 1953; 12 oz. Reed-Prentice, 1951; 12 oz. Watson-Stillman, Model E; 16 oz. H.P.M.'s, 1948 & 1954; 16 oz. Reed-P; 16/20 oz. R-P, 1956; 20 oz. H.P.M. 1954; 20 oz. Lester 1951; 48 oz. Watson, 1950; 200 oz. H.P.M. 1955; vertical DeMattias. Watsons. Lesters, Impcos; double end tumblers, ovens, grinders, etc. Partial listing—other equipment available. Acme Machinery & Mfg. Co. Inc., 2315 Broadway, New York. N.Y. Su 7-1705.

FOR SALE: 1—Elms 200 ton self-contained molding press; 1 Dunning and Boschert 650 ton hydraulic press; 48 x 36" platens; 1 Royle 2" electric extruder; 1 Ball and Jewel #1 Rotary Cutter, 15 HP; 1 Stokes Model T preform press; also mixers, choppers. presses, mills etc. Chemical & Process Machinery Corp., 52 Ninth St., Brooklyn 15, N. Y.

IMMEDIATE DELIVERY: ⅛" to 6" Robbins pipe die with bushings and mandrel to produce 1¼" pipe. Water cooled mandrel equipped with heaters. Never Used. Offered at sacrifice. Reply Box 2627, Modern Plastics.

FOR SALE: All in stock—3—4'x7' Vulcanizers, ASME 125# WP, 650° F, Quick-opening doors. 3400 HP Farrel-Birmingham horizontal reducer. 7500 HP Falk horizontal reducer. 40 HP rotary knife cutters or rubber hogs. 6 oz. Injection Molders—1942 Watson-Stillman, 1947 Lester. Double arm sigma blade mixers—2¼, 5, 10, 20. 30. 60, 75, 100, 150 gal., stainless steel and steel. Rotary & single punch Tablet or Preform Presses—Stokes "R", "F", "DD-2", "RD-4", Kux rotary 21, 25 punch. We want to buy your idle, space-consuming equipment. Perry Equipment Corp., 1429 N. 6th St., Phila. 22, Pa.

FOR SALE: 50 T. W. Stillman Transfer Press new '44. Royle 2" Extruder, Perfected #1, reasonable 32-22-16-12-8-6-4-2 oz. Injec. Mold. Mchnes #9 Std. Upacting geared toggle press 200 T. Complete compounding plant, will sell separately, conveyors, crushers, etc. National Extruders 3½", new '43. Eveready: Box 638, Bridgeport, Conn. EDison 4-9471-2.

FOR SALE.
Late model 16 oz. HPM injection molding machine with latest heating cylinder. Excellent running condition, can be seen in operation in New York area.
Reply box 2626, Modern Plastics.

FOR SALE: One (1) Standard DeMattia Model "G", Vertical, 12-ounce capacity injection molding machine Price—$6,500.00. Two (2) DeMattia Model "G2", Vertical, 4-ounce capacity with increased capacity heating cylinders, injection molding machines Price $4,500.00 each. All machines are operating and can be seen by appointment. Reply Owens-Illinois, P. O. Box 1035, Toledo 1, Ohio. Attn.: M. S. Carr.

Machinery and equipment wanted

WANTED TO PURCHASE: Used Auto-Vac or Vac-Form 30x50 or 24x36 with drape attachment. Must be in excellent condition and 1954 or later model. Reply box 2621, Modern Plastics.

Materials for sale

FOR SALE: 15,000 pounds red reprocessed cellulose acetate, 26,000 pounds black reprocessed cellulose acetate. MS flow-material guaranteed, priced to move at $.22 per pound, f.o.b. New York. Reply box 2601, Modern Plastics.

Materials wanted

WANTED.
Plastics Scrap and Rejects of all kinds. Ground and unground. Also rejected molded pieces and surplus virgin molding powders. Top prices paid.
Reply Box 2609, Modern Plastics.

(*Continued on page* 312)

GRUMMAN S2F TRACKER, Navy's newest sub destroyer, has wing-tips and tail-fin parts of reinforced plastic molded from prepreg. Discussing new parts is Frank Newsham *(right)*, supervisor of reinforced plastics, Grumman Aircraft Engineering Corp., with H. J. Reid *(left)*, plastics sales manager of Standard Insulation Co., East Rutherford, N. J., and Dr. Alex Sacher, Standard's technical director. Standard is supplier of STANPREG, a HETRON-based prepreg.

Now...mold reinforced plastic parts like these with

fire-retardant HETRON®-based prepreg

Get physicals to meet toughest specs . . . flame resistance . . . wet-strength retention, with newest ready-to-mold material

Now you can meet the most exacting requirements for reinforced plastic parts that must be strong, tough, and flame-*retardant*.

You get these properties in a new HETRON-based prepreg material that cuts your molding costs to a new low—and lets you meet requirements too stiff for conventional reinforced polyesters.

Faster, easier molding

This HETRON-based prepreg gives you all the excellent physical, chemical, and electrical properties of glass-reinforced polyester. You buy it in convenient rolls of fibrous glass, *pre-impregnated with* HETRON *resin*—ready for molding.

Composition of the prepreg matches your needs. You eliminate weighing, mixing, pouring of resin. You get a fast, clean, waste-free molding job. Prepreg is produced by continuous methods rather than in batches, so high uniformity is assured.

Get these extras with HETRON

HETRON differs from other polyesters in having permanent locked-in fire retardance. Chlorine, bonded tightly into the molecule, results in a super-polyester that *will not support combustion.*

With prepreg based on HETRON, you also get:

1. *Superior physicals*—exceptionally high tensile, flexural, and impact strengths for which HETRON resins have become known.
2. *Smooth, glossy surface*—unusual resistance to shrinkage and cracking. HETRON parts can take a baked-on alkyd finish without surface crazing.
3. *Wet-strength retention*—over 90% of physical properties retained after two-hour water boil.

Make this trial yourself

You'll find that on many jobs the cost of HETRON-based prepreg is more than justified by the savings you make in extra molding convenience, speed, cleanliness, and tighter quality control.

To discover what this newest prepreg material can do for your molding operations, let us send you names of leading prepreg suppliers. Then try out a roll in your shop. We make the HETRON resins only—we'll be happy to send you technical data. Write today.

DUREZ®

Plastics that fit the job

DUREZ PLASTICS DIVISION

HOOKER ELECTROCHEMICAL COMPANY

3009 Walck Road, North Tonawanda, New York

HOOKER CHEMICALS PLASTICS

(Continued from page 310)

PLASTICS MACHINERY

Cutters, Rotary, Plastic

Cumberland #½ with 5 HP Motor
Ball & Jewell #1 with 10 HP MD

Extruders

Hartig 4½" Elec. Htd. 96" Barrel, 40 HP. U.S. Vari-Drive.
Stokes—Windsor Model RC-1000 Twin Screw 10 HP Vari-Speed Drive

Injection Molding Machines

2 Oz. Van Dorn, Oversize Cylinder, Model H-200
8 Oz. Reed-Prentice Double Link
12 Oz. HPM Model H-300-12
16 Oz. Reed-Prentice No. 10-E-16, Elec. Htd., 1948

Mills, Rubber/Plastic

18" x 50" Farrel, Rubber/Plastic, 75 HP MD

Presses, Molding

15 Ton Baker Fully Automatic
15 Ton Stokes No. 200 D-2 Automatic (10)
15 Ton Dennison 12 Station Indexing Table, 10 HP MD Pump
30 Ton Baker Full Automatic Model 958, Excellent Condition, New 1951
40 Ton Francis, 4 Opening, 12" x 12" Elec. Heated Platens
50 Ton Stokes, Semi-Auto., Self Cont.
75 Ton Watson-Stillman Fully Automatic, 20" x 20" Platen 5 HP MD
100 Ton Stokes Standard Semi-Automatic, Power System, Timing Controls
100 Ton Lake Erie Hi-Speed, 24" x 24" Bed, 12" DLO, Self Cont.
113 Ton French Oil Mill, 6 Opening, Elec. Htd., Platens 15" x 18"
113 Ton R.D. Wood, 5-Opening Elec. Htd. Platens 14" x 20"
150 Ton Stokes Standard Semi-Automatic, Power System, Timing Controls
175 Ton Viceroy Slab-Side 24" x 24", Elec. Htd. Platen with Hand Pump
200 Ton Stokes Semi-Automatic, Power System, Timing Controls
225 Ton Farrel 14" Ram x 18" Stroke, L-R 26½" x F.B. 24½" 7½ HP MD
300 Ton Stokes Semi-Automatic, Power System, Timing Controls
300 Ton Dunning & Boschert 30" x 30" Platen
314 Ton Lake Erie 36" x 36" Semi-Automatic, Push Button Controls 10 HP Pump & Motor
625 Ton Farrel, Steam Platens 52" x 52", Pump, Mtr., Controls, Under Power
700 Ton Erie, Multi-Opening 42" x 42" Steam Platens

Presses, Hobbing

400 Ton Robertson 13" Ram x 4" Stroke complete with pumps & 15 HP MD

Furnaces and Ovens

Megatherm, 3/60/220, 3 KW, 2-3 lb. Phenolic Per Min. (8)
Despatch Mdl. P1hd-8 8 Drawers, 12 x 18 x 2½" (2)

Tablet Machines

Model "E" Stokes, Complete with MD
Model R Stokes, Single Punch, Variable Speed Motor Drive, 3 HP
No. RB-2 Stokes, 16 Station, Motor Drive, 2 HP
Model 45 Defiance, 200 Ton, 15 HP, Vari-Speed, MD
Model F, Stokes, Single Punch, MD
No. 5 Arthur Colton, Motor Drive, 3 HP
No. DDS-2 Stokes, 23 Stations, US Vari-Drive, 10 HP
Model T Stokes Hydraulic Equalizer, MD
Model 280-G Stokes Preform Press. 100 Ton Dual Pressure—Late

Mixers

Model "B" Banbury Lab type. Never used
No. 3A Banbury, 150 HP Md Rubber/Plastic
No. 3 Banbury 75 HP MD Excellent Condition Slide Door Construction

Calenders

9" x 48" American Tool 4 Roll Doubling, Belt Drive
6" x 13" Elec. Htd. 6 Roll Lab Type, 7½ HP MD

Pelletizers

Mitts & Merrill Model 10-N-6 15 HP V.S. Drive

Make Us Your Prime Source for All Types of Plastics Machinery

Hydraulic Presses from lab size to 5,000 ton
Injection Molders from ⅛ oz. to 60 oz. size
Extruders from lab size to 12"
Plastic & Rubber Mills and Calenders up to 84" size
Tablet Preform Presses, single punch and rotary, all sizes
Mixers all sizes, types and capacities

Also a complete selection of tumbling barrels, take-up equipment, hydraulic power units, pumps, ovens, blenders, scrap cutters, pelletizers, coating equipment and laminating equipment.

JOHNSON MACHINERY Co.
683-P Frelinghuysen Ave., Newark, N.J.
What Do You Need? What Have You To Sell?

WANTED.
Vinyl, polyethylene and styrene scrap for our manufacture of molding and extrusion compounds. We can use rigid from vacuum forming, lumps, bleeder, slabs, trimmings, rejects—anything suitable for reprocessing. Send samples and details or telephone. Steady buyers since 1940.
Rotex Rubber Company, Inc.
1-23 Jabez Street, Newark 5, N.J.
MArket 4-4444

YOUR BEST MARKET for Surplus Molding powders and Scrap Plastics—Gem City Trading. Contact Gem City for best prices on polyethylene, styrene, nylon, butyrate and acetate.
Gem City Trading—P. O. Box 941
Dayton I, Ohio—Hemlock 2121

ACRYLIC SCRAP WANTED.
Acetate, Butyrate, other Plastic Scrap in any form Claude P. Bamberger, Inc. One Mount Vernon Street, Ridgefield Park, N.J. Telephone: HUbbard 9-5330.

Molds for sale

FOR SALE: 1—8 cavity economy wall tile mold—excellent condition. 1—13 cavity cap, feature, and bull-nose mold—excellent condition—will sacrifice. Reply Box 2606, Modern Plastics.

Help wanted

FINISHING SUPERVISOR: Large progressive Chicago plant. To supervise spraying, hot stamping, buffing and vacuum plating operations. Excellent starting salary plus good opportunity for advancement. Reply Box 2614, Modern Plastics.

CHEMICAL ENGINEER: Resins and Plastics. A leader in the Chemical industry with established and expanding product line of synthetic resins has a challenging opening for an experienced development engineer. Applicant should have a B.S. or M.S. in Chemical Engineering with 5-8 years experience with special emphasis on the manufacture of resins and plastics. The position involves pilot plant synthesis and development of new existing resins at central staff installations on the East Coast over 100 miles from New York City. If interested, please send resume (no reference check without permission) with salary history to: Reply Box 2605, Modern Plastics.

INJECTION MOLDING SUPERVISOR: To be in charge of 20 machine operation, operating on a 3 shift basis. We are a leading Chicago firm who just completed $250,000 expansion program. This man must know equipment, set-ups and material and must have an engineering approach to molding and mold design. He must have administrative ability and must be cost and quality conscious. Salary open and commensurate with ability and experience. Reply Box 2608, Modern Plastics.

FOREMAN: Compression Molding—must be capable of full responsibility for production, quality, maintenance and personnel. Unusual opportunity to join a growing molder in the Metropolitan area. Submit full details and salary desired—all replies confidential. Reply Box 2620, Modern Plastics.

CHEMICAL ENGINEER: Unusual opportunity for a recent graduate to build a sound future with a progressive young management team in an expanding New England rubber company. Versatility and ability to quickly assume broad responsibility in new product and process development necessary. Experience in cellular polymers desirable but not essential. Submit resumes to Reply Box 2615, Modern Plastics.

WANTED: Estimator and sales correspondent with chemical engr. background preferred. Substantial, rated Eastern extruder. Permanent position. Send resume and salary requirement. Replies held in strict confidence. Reply Box 2607, Modern Plastics.

FOREMAN: Foreman for Finishing Department in fast growing Ohio injection molding plant. Must be experienced in spray painting and hot stamping of thermoplastics. Capable of setting up job procedures. Securing High rate quality production and planning department layout. Please send detailed resume of experience and education, and salary requirements. Reply Box 2604, Modern Plastics.

WANTED: Chemists, Engineers, Tool Men, and Methods Men, preferably experienced in the reinforced plastics field. Young and rapidly expanding manufacturer in midwest. Excellent opportunities. Applications will be kept confidential. Reply: The Glastic Corporation, 4321 Glenridge Road, Cleveland 21, Ohio.

RESIN CHEMISTS: For research, development, and production of polyester resins. Minimum experience 2 years. Excellent opportunity with aggressive manufacturing company. Modern plants and lab facilities in Chicago area. Write to E. F. Wagner, Mgr. of Development, Witco Chemical Company, 6200 West 51st Street, Chicago 38, Illinois.

WANTED: Young man (not more than 27), preferably with some experience in plastic raw material sales, required for new position with excellent prospects. New York metropolitan area. All replies confidential. Reply Box 2624, Modern Plastics.

PLASTICS SUPERVISOR: Leading Midwest extruding and vacuum forming company has opening for experienced production foreman. Permanent position for man with sheet extrusion and vacuum forming experience. Excellent opportunities for advancement. Salary open. Send complete resume to Reply Box 2625, Modern Plastics.

MANUFACTURERS' REPRESENTATIVE WANTED: An old established manufacturer, rated AAA1, specializing in mass production custom made items for industry particularly where they involve the decorating arts, has opportunity for successful and established manufacturers' representative, on commission, in various areas throughout the United States. The unusual part about this opportunity is that we supply a completed service, i.e. everything from design to completed product assembly including plastic, metal stampings and die castings. Give a complete history of your background in first letter. Reply Box 2611, Modern Plastics.

AGENTS: Experienced plastics salesmen to sell our custom extrusions and vacuum formed parts. Full support from aggressive, capable company. Protected territory; some midwest open. Write for complete proposal: Quick Plastics, Box 66, Jackson, Michigan.

(Continued on page 314)

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(*Continued from page* 312)

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SALESMAN: Experienced Raw-Material Plastics Industry. Manage vinyl-stabilizer sales. Company located Metropolitan New York. Reply Box 2602, Modern Plastics.

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WANTED: Sales representative calling on electronic and industrial parts manufacturers to represent custom molder specializing in precision miniature injection molded parts of nylon and other thermoplastic materials. Commission basis. Reply stating territory covered, age and present lines. Reply Box 2612, Modern Plastics.

Situations wanted

POSITION WANTED: AT PRESENT TECHNICAL DIRECTOR AaA-1 COMPANY DIVISION operating in non-ferrous foil rolling, extrusion, laminating, coating, vacuum metal evaporation. Metals, papers, boards, films, adhesives and colors. Electronics, containers and structural. Military and commercial. Technical and policy. Wish to change; available for one or two days per week on permanent basis. Reply Box 2610, Modern Plastics.

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PLANT SUPERINTENDENT: Cost-minded with twenty years experience in injection molding of proprietory items, plant set-up, developing new plastic products, mold design, toolroom supervision, vacuum forming, extruding of sheeting, desires to locate with company where his know how can be fully utilized. Reply Box 2619, Modern Plastics.

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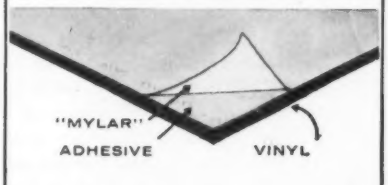

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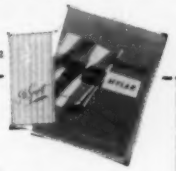

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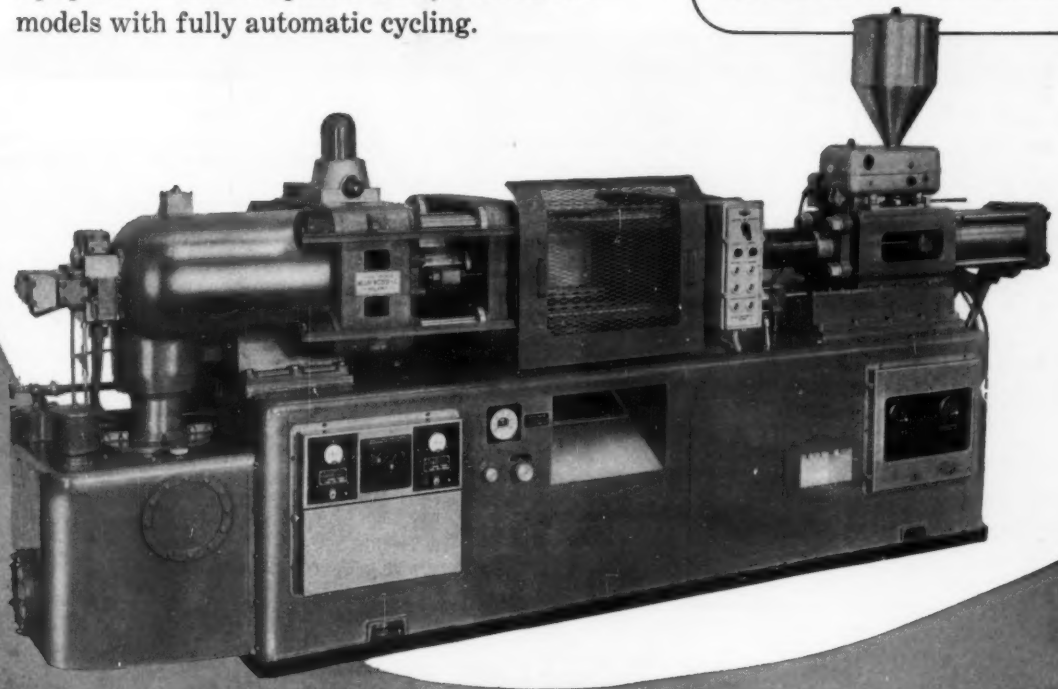

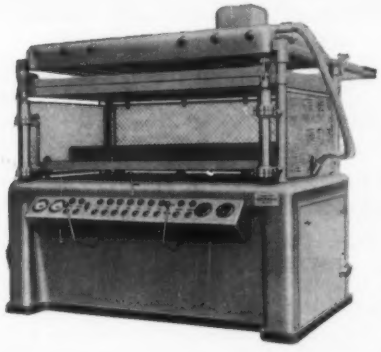

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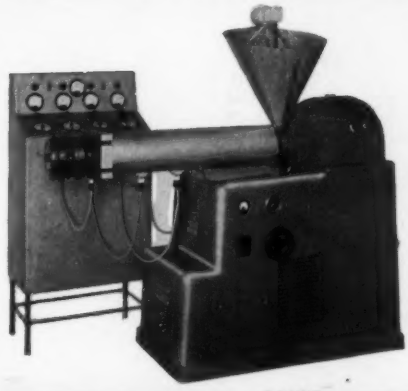

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DIAMOND COMPOUND R-4		Type I Rigid PVC fittings, valves and pipe Calendered Rigid PVC Sheeting	Approved by National Sanitation Foundation Superior heat stability and easy processing characteristics permit use in conventional molding equipment Superior chemical resistance
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G-E PHENOLIC COMPOUND FOR MOLDING IGNITION SYSTEM PARTS

A new G-E phenolic was chosen by this leading auto maker for molding distributor caps, rotors and coil tops of ignition system parts on its fine cars.

Why? Because this new phenolic best matched the customer's rigid specifications for electrical and mechanical properties. Because it is a fast-cure molding powder with good preheat and flow characteristics. Because it is easy to mold, has high dimensional stability.

Their tests proved that this general purpose compound was strong, light, shock resistant. Dielectric properties were excellent. And "third-peak loss" requirements were met consistently.

G-E phenolic molding powders are being used by molders today in a variety of exacting applications. If you are called upon to meet unusual specifications in a molded part, bring your problem to General Electric. The G-E technical service staff can help you select and process the G-E phenolic best suited for your job.

For more information about G-E phenolic molding powders, write General Electric Company, Section MP-9, Chemical Materials Dept., Pittsfield, Mass.

Progress In Phenolics

GENERAL ELECTRIC